THURSDAY, MAY 27, 1915.

THE SCIENCE OF VULCANOLOGY.

The Problem of Volcanism. By Dr. J. P. Iddings. Pp. xvi+273. (New Haven: Yale University Press; London: Oxford University Press, 1914.) Price 21*s.* net.

THIS work is the latest published of a series issued by the Yale University, acting as trustees for the Silliman Memorial Fund; the fund consists of the sum of 85,000 dollars left to provide for the delivery and publication of annual courses of lectures "to illustrate the presence and providence, the wisdom and goodness of God, as illustrated in the natural and moral world." Although the terms of the bequest strikingly recall those of the once-celebrated "Bridgewater Treatises," yet the testators of the Silliman Fund qualify the statement of terms by a declaration of a belief that "any orderly presentation of the facts of nature or history contributed to the ends of this foundation more effectively than any attempt to emphasise elements of doctrine or of creed." In the end they conclude that dogmatic and polemical theology should be excluded, and that "the subjects should be selected from the domains of natural science and history, giving special prominence to astronomy, chemistry, geology, and anatomy." A comparison of the terms of the Bridgewater and Silliman foundations give a by no means unsatisfactory impression of the improved relations between the representatives of natural science and theology which have arisen in the course of the last century.

With characteristic impartiality the authorities of Yale University have invited representatives of various branches of science to give clear and up-to-date presentments of the condition of our knowledge on the subjects selected by them. The successive courses of lectures have been given by Profs. J. J. Thomson, Sherrington, Rutherford, Bateson, and Sir W. Osler from this country; by Profs. Nernst and Max Verworn from Germany; and by Arrhenius from Sweden; only three of the published courses, indeed, are by American men of science.

For the science of vulcanology no better representative could possibly have been found than Dr. Iddings, and no more striking illustration of the progress of investigation and theory could be given than his discussion of the problem. Fifty years ago the question was thought to be virtually settled by the assumption of a molten central mass constituting the earth's interior, or at least of pockets of such heated material at moderate depths; granted this, it was believed that all the explosive and eruptive actions of volcanoes could be accounted for by the access of sea-water to these incandescent materials through fissures in the earth's solid "crust." Now, after a full discussion of the astronomical, physical, chemical, and geological evidence involved, the author shows that there are no valid grounds against the conclusion that the earth's interior is solid and cold, and that all thermal action may be attributed to radio-activity, whilst many problems of far greater complexity than were ever thought of in the past await solution.

Although every outstanding branch of the inquiry meets with full and sympathetic treatment at the hands of the author, yet it is on the characteristics and relations of volcanic rocks that he writes with special authority, and more particularly on the light which has been thrown on petrology by microscopic research, the branch of study with which Dr. Iddings has been so long identified. But whether dealing with such problems as those belonging to his own studies or such varied questions as are suggested by the characters of nebulæ, Dr. Iddings is equally at home; and nowhere, to our knowledge, can there be found an account, so complete and illuminating, of all the varied lines of research bearing on the subject under discussion. A word of praise must be added for the numerous and beautiful illustrations, while the printing of the work exhibits all those excellences which we are accustomed to find in scientific works issued in the United States. J. W. J.

LIQUIDS UNMATHEMATICALLY TREATED.

(1) *The Dynamics of Surfaces: an Introduction to the Study of Biological Surface Phenomena.* By Prof. L. Michaelis; translated by W. H. Perkin. Pp. viii+118. (London: E. and F. N. Spon, Ltd., 1914.) Price 4*s.* net.

(2) *Motion of Liquids.* By Lieut.-Col. R. De Villamil. Pp. xiv+210. (London: E. and F. N. Spon, Ltd., 1914.) Price 7*s.* 6*d.* net.

(3) *Liquid Drops and Globules: Their Formation and Movements.* By C. R. Darling. Pp. x+83. (London: E. and F. N. Spon, Ltd., 1914.) Price 2*s.* 6*d.* net.

(1) THE first part of the title of Dr. Michaelis's book is erroneous and misleading, for a mathematical physicist will fail to find anything whatever in these pages dealing with the dynamics of surfaces. It treats entirely of certain physico-chemical and electrical phenomena connected mainly with surfaces of separation of different media, and it makes no attempt at a rigorous theoretical investigation of these. As an illustra-

tion of the style in which the subject matter is treated, about seventeen pages are devoted to a discussion of surface tension of a far more elementary character than is usually presented to an average B.Sc pass candidate working in the laboratories of a British university, and on the other hand the thermodynamical formulæ which follow are written down without any consistent attempt at lucid explanation. Had the book been described under the last portion of the title alone it is not improbable that it might have proved of use to biological students who are weak in their knowledge of physics and chemistry, but even they would do well to remember that a little learning is a dangerous thing, and the danger is greatly increased when this small cargo of information is allowed to sail disguised under the flag of a highly mathematical treatise.

(2) In the matter of sailing under misleading colours, Col. De Villamil is another delinquent. He recently published an "A.B.C. of Hydrodynamics" containing little or nothing on that subject which would be of use to a student pursuing a university course of study in hydrodynamics. By adopting a title closely resembling that of Lamb's classical treatise, he thrusts on our attention a small book devoted almost exclusively to common or garden *hydraulics*, and dealing far less with the actual motions of the fluids than with the resistances which they exert on solids. Many of his statements are not very clearly expressed; for instance, what does he mean by saying that "in an incompressible liquid which *has no free surface and whose envelope is inextensible all bodies moving in steady motion in it are stream-line*"? (p. 199), or, again, that "if any flat body *of any shape* be caused to move *irrotationally* round a fixed point, *every point in the body* will describe a figure which is an *inverted reflexion* of the body moving"? (p. 205).

Had Col. De Villamil claimed to write about "Practical Hydraulics," it is probable that a good deal of the subject matter of the book would have been of use to engineers. In posing as a mathematical physicist the author is probably defeating his own ends.

(3) Mr. Charles Darling's lectures on "Liquid Drops and Globules" present to an unscientific reader a simple and lucid exposition of a number of pretty experiments on liquids, many of which can be repeated by the most uninitiated at a trifling expense. The apparatus required is mostly of the simplest possible character, though for lecture purposes a lantern attachment is necessary. We note the author's recommendation of tap-water as superior to "distilled water, which often possesses a surface so greasy as to retard or even entirely prevent the desired result." Curiously enough, the present reviewer's experiences in spreading diatoms on cover glasses have confirmed this difficulty of greasiness, and for mounting in resinous media the best results were frequently obtained by evaporating from a thick convex drop of ordinary filtered water heated to a high temperature, the impurities in the water being deposited round the edge of the cover, where they could be wiped off. The greasiness so often present in distilled water frequently caused the drop to tear away from the edges of the cover long before it had became reduced to a mere film, and often left actually more deposit on the diatoms than the less pure liquid. The same occurred when the drop was initially too thin.

Readers who are unable to specialise in science, but who wish to interest themselves in some of its developments, can do no better than study a book of this kind. The experiments described form a delightful recreation for those engaged in duties of a non-scientific character, and at the same time they are directed on such lines as are likely to give them the closest insight into the intricacies and difficulties of scientific investigation. G. H. B.

INSECTS AND MAN.

(1) *Flies in Relation to Disease—Bloodsucking Flies.* By Dr. E. Hindle. Pp. xv+398. (Cambridge: At the University Press, 1914.) Price 12*s.* 6*d.* net.

(2) *Insects and Man.* By C. A. Ealand. Pp. 343. (London: Grant Richards, Ltd., 1915.) Price 12*s.* net.

(1) THIS book is an attempt to combine in one volume the entomological information required by the doctor and the medical facts required by the entomologist, with regard to bloodsucking flies and the diseases they carry. The literature on this subject, being a special one, is very large, and is being added to daily. The whole subject is one that dates back only twenty years, and to attempt to present in a small compass a summary of these two aspects is no easy task. To do it successfully requires exceptional judgment in selecting what to omit and what to include, as well as a first-hand knowledge of both aspects of the subject. There is no evidence that the author has the latter, and the volume bears the impress of the laboratory, not of the tropics where these insects live and where men die daily from the diseases they carry. No one with actual tropical experience would omit from an account of measures taken against mosquitoes the use of traps and fumigants; no one with a first-hand

knowledge of insects would deal with technical points of entomology as is here done; the frontal suture is mixed up with the frontal lunule, the different venation systems are not tabulated, the value of the antennæ in classification is not made clear, there is an error about peripneustic, and so on. The volume, so far as the entomology goes, is largely a selection from Sharp's "Insects" (Cambridge Natural History) and Alcock's "Entomology for Medical Officers." These excellent works are, of course, listed in the references, but there does not seem to be any obvious reason for summarising parts of them.

The medical and the entomological student will find the references valuable. The doctor or sanitary officer who is not seeking special knowledge will find the volume a surprising revelation of the great importance attaching to this branch of entomology, and we wish it might do much to educate public opinion on this very vital point.

That is so more especially in England, where it is impossible to realise the part played by insects and the importance of these diseases. In this respect accuracy of technical detail and an up-to-date summary of the scientific aspect is less important than picturesque description and lucid writing, both characteristics of this volume. We commend it to the public which reads general science, and to medical men desirous of keeping their knowledge of this subject up to date. It is well illustrated and produced, and an exceedingly readable volume.

(2) The author has put together a series of abstracts of published works on various phases of economic entomology under chapter headings such as "Insects and Human Disease," "Insects and Plants," "Beneficial Insects," and so on. In the main, the work to which attention is given is that of the American worker, and the volume as a whole is very largely taken up with selections from recent American authors. The selection of subjects is curiously uneven: quite obscure household pests are mentioned, while really serious ones are omitted; the bee as a honey-producer and the silk-worms are omitted while the Chinese wax-insect is discussed. In agricultural and horticultural entomology one gets the impression that, while much progress is being made in America, none is being made elsewhere. The Americans are quoted as the pioneers in the use of parasites to control pests, while the pioneer work of Perkins in Hawaii is not referred to.

The author lays no claim to first-hand knowledge of the subject, but has clearly read voluminously from American works. His abstracts are well written, but the accuracy due to personal knowledge of the subject is conspicuously absent. No one would contend, for instance, that "the control of scale insects and aphides, therefore, in such districts practically resolves itself into control of the ants," though the Argentine ant is, of course, a factor in spreading scale insects; nor would anyone conversant with the literature say of the codlin moth, "no insect of economic importance has received so much attention from entomologists." The curling of the leaves of Prunus is not caused by the fungus that lives on the secretion of the aphides; only a portion of the Coccidæ cover themselves with a scale; in no insect is the duration of the life-cycle to be "counted in hours"—and so on. It is far too easy to find misleading statements in general, which would not occur to an author who had other than a purely book knowledge. We would have suggested that to the title might be added the words "The romance of," for one feels that it is the "romantic" element of the journalist that guides the choice of subject; picturesque detail and local colouring is the object sought, and no methodical attempt has been made really to "compile a concise summary of the varied relations of insects and man," as the author claims (page 21). A great deal is said about certain sections of the subject, but the ground is not covered in any complete or methodical manner.

It is probably inevitable that a new subject will be exploited by the journalist seeking picturesque "copy," but we hope it will not again be presented in a serious form calculated to mislead the student into thinking he has a concise summary of the subject; and if we must have such books as this, let us hope they will take into account the work done in this country and in our Colonies, every whit as good, though less blatantly set forth in sober reports, with no touch of the American journalese. We have to do a great deal yet to educate the British public (particularly the ruling class) to make them realise that there is a big future for economic entomology, but it will not be done by quotation from American entomologists, and the implication that they and they only can do the work. H. M. L.

CULTURE AND METAPHYSICS.

(1) *German Culture: the Contribution of the Germans to Knowledge, Literature, Art, and Life.* Edited by Prof. W. P. Paterson. Pp. x+384. (London: T. C. and E. C. Jack, 1915.) Price 2*s.* 6*d.* net.

(2) *The Principles of Understanding: an Introduction to Logic from the Standpoint of Personal Idealism.* By H. Sturt. Pp. xiv+302. (Cambridge: At the University Press, 1915.) Price 5*s.* net.

(3) *Essays Towards a Theory of Knowledge.* By A. Philip. Pp. 126. (London: G. Routledge and Sons, Ltd., 1915.) Price 2*s.* 6*d.* net.

(1) THE term *Kultur* is the equivalent of our "civilisation"; *Kulturgeschichte* is "history of civilisation." In a secondary sense the German term is narrowed to mean "the organisation of a people's life in which the ideals of religion, morality, and science come to realisation." The popular present-day use of the term, therefore, actually coincides with our "culture," "civilisation viewed on its higher side." It is only Chauvinist writers who have reduced it, at a very ill-chosen time, to the connotation of morality.

The popularly written essays, which Prof. Paterson has brought together, on Germany's contribution to the world's culture have the merit of impartiality. It is a mistake to suppose, by way of a reaction from Germany's pretensions to pre-eminence, that her work is second-rate and second-hand, however industrious.

In philosophy Mr. Lindsay observes that the German genius is supreme in the production of metaphysical systems. Such work suits the German mind, which has produced both "the dry-as-dust and the romantic fairy-tale." "The first question a German asks about a philosopher is—'What is his *Weltanschauung*?'"—his "world-vision." Could we talk about the world-vision of Locke or Hume? Mr. Lindsay is probably right in regarding German philosophy as "the most characteristic contribution which Germany has made to the common treasure of the human spirit." A typical feature of it is the passion for monism, Kant alone being an exception.

The best and most detailed essay in this book is that on science by Prof. J. Arthur Thomson. "It is probable that the Germans in their normal condition have the most orderly minds in Europe," but they have made far-reaching discoveries as well. Prof. Thomson sketches fully the course of investigation in biology, physics, and chemistry during the last hundred years, and places the German contributions in the order of their appearance, so that the reader may estimate their importance and compare them with those of other peoples. In biology the cell-theory, which "must be placed beside the evolution theory as one of the foundation-stones of modern biology," was almost entirely the work of Germans. An interesting episode of chemistry is this:—

"Sixty years ago an obscure German chemist obtained an oily liquid from coal-tar oil, which gave a beautiful tint with calcium chloride; five years later, another separated a similar liquid from a derivation of coal-tar oil."

Hofmann identified these with Zinin's oil of indigo, and called them by his term "Anilin." Perkin made the practical application of this knowledge, and

"the industry started by Perkin's discovery passed from Britain to Germany, but the honours of scientific discovery were shared by both countries."

Prof. Thomson concludes with a useful qualification:—

"the probable fallacy of using the history of science as an index of national or racial qualities," but he notes that "the reading public for concrete science is enormously greater in Germany than in Britain, and that there is a stronger faith (which we believe to be warranted) in what science can do for the amelioration of human life."

In Prof. Sadler's account of education two points may be marked:—

"England hesitated between two opposing theories, the theory of State control and the theory of group autonomy under the general supervision of the State. Germany came to a decisive conclusion on this fundamental question of procedure. Great Britain (and particularly England) remained divided in conviction about it, and therefore irresolute in policy. Germany standardised her education upon a system. Britain, distrustful of State control, compromised."

Not only English, but German observers have often remarked that the intellectual apprehension of the average educated German is ten times quicker than that of the average educated Englishman. But the intellectual judgment of the average educated German is most uncertain and weak, and often most conventional. The German will form ten foolish inductions to the Englishman's one. This corresponds to a real difference in temperament, between the cool, phlegmatic Briton and the emotional German. One result of this emotionalism seems to be the extraordinary solidarity of both German culture and German national feeling; yet British solidarity is as real, though longer-circuited.

(2) After the results of understanding, the principles of it, and the principles of the reality which we try to understand. Mr. Sturt writes from the point of view of personal idealism, and treats logic dynamically. His main text is the creative, inventional power of understanding. The foresight of understanding he advances as the strongest argument against epiphenomenalism, such as that of Shadworth Hodgson, according to which

"all the facts of consciousness are negligible by-products of physico-chemical energies in the

nervous system." So Mr. Sturt says "no physico-chemical energy ever foresaw anything. It is consciousness, then, that foresees and plans."

But he does not explain consciousness. Consciousness, again, is characterised by passion; by neglecting this fact and the fact that it is "total-working," intellectualism "has obscured the true nature of intelligence."

On the fundamental nature of consciousness, creative and passion-wrought, Mr. Sturt has a big assumption, already made by McDougall, viz., "a true logic is impossible without animism." He has some interesting observations and phrases:—

"Felicitous naming, felicitous phrasing add enormously to the power of thought," especially, we may add, when thought is being thought about. Thus, the soul is not weak and shadowy, a slender breath, *animula vagula blandula*, nor a mere point; "a human soul is very large"; it has a wealth of faculties "correspondent to the richness of the world."

If the soul is a big thing, then the mental sciences, including logic, are bigger than the writers of the past would lead us to suppose. But Prof. Stout has said, "to the psychologist the conception of a soul is not helpful." Further, there is a social soul; a society of a hundred individuals is more than a hundred souls. On the "generation" of souls he says:—

"There must be some source of soul-life . . . we cannot say that we are not surrounded by a soul-element, and that the whole universe is not pervaded by soul-life whence individual souls come into being as they are wanted."

This is precisely the doctrine of the Dayaks and other savages of the East Indies.

(3) "Dynamic" is nowadays a blessed word. It assists Mr. Philip towards a theory of knowledge. In this, the ultimate reality is "potential energy." "Sensation is obstructed action"; "sensations only mark the interruptions in the dynamic activity in which we as potent beings partake." But these obstructions do not constitute the essence of our experience, they merely denote it. For this essence we must look to our activity as such. Space is the absence of physical obstruction. Time is the periodicity of natural force. Mr. Philip has some useful inferences drawn from the experiences of the blind, recently recorded by M. Pierre Villez. Particularly significant is his insistence throughout the book (which contains four short essays) on the necessity for metaphysics to found upon physics, a necessity hitherto almost totally ignored.

A. E. CRAWLEY.

OUR BOOKSHELF.

Canadian Institute: General Index to Publications, 1852–1912. Compiled and edited by J. Patterson (Hon. Secretary). Pp. 518. (Toronto: University Press, 1914.) Price 5.00 dollars.

THE pioneers of a new country are mainly preoccupied in developing its material resources, but there is always a remnant faithful to the intellectual life. Cut off from the companionship of their peers, these men gather themselves into local societies, and adopt the common form of regular meetings for the reading of papers.

Some two score such societies were scattered through the Dominion when, in 1882, the Marquis of Lorne founded the Royal Society of Canada. The older societies were not superseded, but affiliated, and they report annually by delegates on their work for the year. The most important of them were the Natural History Society of Montreal (founded 1827) and the Canadian Institute of Toronto (1852). It is this latter body which now issues, in a handsome volume of 518 double-column pages, an index to its 35 volumes of publications from 1852–1912.

The index has been prepared with much care and labour, the most important papers being indexed almost by paragraphs, and as it is arranged like a dictionary, alphabetically, it ought to be easy to find anything to which there is the slightest clue.

The pity of all such series is that they become the burial-ground of much that is valuable beneath heaps of rubbish. There are hundreds of references here to "papers" (especially in the early volumes) which are merely translations of some passage from the classics, fugitive reviews of forgotten books, scraps of antiquarian lore from anywhere on earth except Canada. But the real core of value is to be found in the original contributions on the history, customs, and folklore of the rapidly vanishing Indian tribes; the early history and settlement of Canada; its geology, minerals, botany, flora and fauna, with their consequent biological problems. Even in physics, though most that is worth while finds its way to European publications, there are observations special to Canada (*e.g.*, peculiar ice-formations) which would have found no record without the labours of her own pioneers of science. Distinguished names like those of Sir Daniel Wilson, Sir J. W. Dawson, and Goldwin Smith are a guarantee that there is much in these Proceedings which ought not to be smothered. This index will enable any student, in spite of the dust, to rescue whatever concerns his own line of study.

Towards Racial Health. By Norah H. March. With a Foreword by Prof. J. A. Thomson. Pp. ix + 326. (London: G. Routledge and Sons, Ltd., 1915.) Price 3*s.* 6*d.* net.

IN this little book Miss March deals with one of the most serious difficulties which lies in the path of those engaged in training the young. Children are taught elementary rules of health in relation to food, drink, and exercise, but sex is seldom

mentioned. The majority of young people are left to find things out for themselves, or from their equally blind or ignorant fellows. The danger of this method, especially in the early days after puberty, when bad habits formed are so difficult to eradicate subsequently, is recognised by educationists, but, as a rule, nothing is done to counteract the evil. Miss March shows that instruction on this most important matter can be given without any loss of delicacy, by making biology a school subject, and by practically studying the development of certain plants and animals. She also very rightly urges that there should be greater frankness and confidence between parents and their children, and that reticence on the part of either should be discouraged. Great pains have been taken to make the biological statements clear and accurate.

The book is addressed to parents and teachers, not to the children themselves. There are many subjects dealt with, such as prostitution and sexual diseases, which it is quite unnecessary for mere children to understand; the evils of the world will become apparent quite soon enough, and we feel sure that these evils would be less if only young men and maidens were, at an early stage, taught to understand and respect their own bodies. It is because Miss March has made a successful attempt to induce parents to realise their responsibilities that we welcome her book.

W. D. H.

The Theory of Measurements. By Dr. A. de Forest Palmer. Pp. xi+248. (New York: McGraw-Hill Book Co.; London: Hill Publishing Co., Ltd., 1912.) Price 2.50 dollars or 10*s.* 6*d.* net.

THE author has prepared this treatise on the theory of measurements to meet the needs of students in engineering and advanced physics, and to impress on them the importance of realising the significance and the precision of the measurements made.

In the first seven chapters the general principles of measurement, the nature and distribution of errors, and the methods which are employed to arrive at the most probable result, are set forth clearly.

Measurements of various kinds are discussed, to show the importance of determining the precision of the result obtained if the operation is to be of any real value.

A general discussion of errors, which is very clearly stated, leads up to the method of least squares, and throughout the subject numerical examples are worked out so that the student may see for himself the treatment of measurements and the errors which arise.

The second half of the book is devoted to a general discussion of the precision of measurements, to which the earlier chapters have formed a suitable introduction. It is in this portion that the author's aim to lead the student to test systematically the results which he obtains is best seen, and the guidance given for the adequate discussion of completed observations and of proposed measurements is most valuable.

The whole subject is clearly and comprehensively set forth, and is illustrated by numerous examples of physical measurements, which are fully worked out. The book is to be recommended to the student as a useful guide to the systematic discussion of measurements and the determination of their adequacy.

M.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Supposed Horn-Sheaths of an Okapi.

ARRIVING in London after an absence of more than three years in the Belgian Congo I have been considerably surprised at what appears to have been a mistake on the part of Messrs. Gerrard, the taxidermists, in connection with the skin and skeleton of an okapi, one of a series obtained recently by me in the Ituri forest.

The okapi in question was sent to the director of the Tervueren Museum in Brussels, and afterwards forwarded by him to Messrs. Gerrard in London; the skin in one case, the skeleton in another. In the box containing the skeleton I had originally packed a number of other bones, including the skull of a very young waterbuck. These bones and the waterbuck skull were taken out in Brussels and retained for the museum according to agreement. Unfortunately, the detached horns of the young waterbuck seem to have been overlooked, and when found by Messrs. Gerrard it was assumed that they belonged to the okapi, with which, of course, they had nothing whatever to do. It would appear, moreover, from a letter in the columns of NATURE of July 9, 1914 (vol. xciii., p. 479), that the late Mr. Lydekker supported Messrs. Gerrard in this belief.

If it is a fact that these two horn-sheaths were labelled as belonging to the okapi I can only say that this was not done by me or any of my servants in the Ituri, none of whom could speak or write anything but Kiswahili, and if any label had been attached in Brussels no doubt it would have been written in French. Nothing is mentioned in my register of specimens about horny-sheaths. On the contrary, I distinctly say, "Horns 1¼ in., skin-covered."

The extraordinary statement that the giraffe-like horns of an okapi, an animal far removed from the antelopes, could in any circumstances have horny-sheaths resembling those of the prongbuck, naturally aroused the interest of Sir E. Ray Lankester, whose knowledge of the anatomy of the okapi is unequalled. I am considerably indebted to him for going into the matter without waiting for my return, and dispelling the illusion. His view of what had probably happened, as stated in his letter to NATURE (March 18, 1915), is perfectly correct, except as regards the "well-intentioned servant."

The whole of my series of seven okapi skins has now safely reached England, I am glad to say, having been, through the kindness of the Belgian Minister, sent direct to London from the West Coast, together with two skeletons and various soft parts preserved in spirit.

Altogether more than eighteen months were spent in

the Ituri forest hunting this scarce and extraordinary animal, and searching for the hypothetical *Elephas pumilio* ("Elephant nairn"), accompanied each day by one of my friends, the little Bambuti pigmies, without whose co-operation and assistance I could have done very little indeed. Elephants were everywhere, but not a sign of any pigmy species could I discover in the Ituri.

On several occasions I saw the okapi alive, sometimes at very close quarters, but so ghost-like, wary, and elusive is it, so difficult to track, even for the little "animal men," and so difficult is it to see in the prevailing gloom, that I only succeeded in shooting two. A third one (No. 531) of the series was shot by Commandant Hedmark, an officer in the Congo service, who spent three days shooting with me at one of my forest camps, and came upon the animal quite by accident.

A fourth (No. 717) was killed, late one afternoon, in mistake for a buffalo, by Mr. A. E. H. Reid, a prospector, also in the Congo service, and given to me. This specimen is of considerable interest, being an old male with well-developed horns some 4 in. in length, and skin-covered except at the tip, where, instead of a tuft of hair, the bony horn-core is bare, somewhat cup-like in shape, and of modified, white, polished, very hard, compact bone. The remaining three skins were procured from natives and are very incomplete.

Hitherto there has been considerable confusion as to the sex to which the comparatively few skulls handled by naturalists belonged, and mainly for this reason there has been a doubt as to whether both sexes or only the male develops horns. There is no question as to the sex of four of my specimens, three males and one female. Two of the males have horns, but the third, being very immature, has not yet developed them. The big female, although an old animal, as shown by the condition of the teeth, has no horns or any signs of developing ossicones. This being so, I think I am justified in saying that my specimens go far towards proving that only the male okapi carries horns.

They also help to prove that the female okapi, unlike most other animals, attains a greater height and bulk than the male, a peculiarity suspected by a writer in *Country Life* (October 25, 1913) as the result of measurements of mounted specimens.

Giraffe-like as the animal seems, and is, it is only when extremely young that the backward slope of the back is very noticeable. It does not feed on any species of water-plant so far as I know. In fact, it seldom frequents low situations near the water. Its food consists of leaves of the undergrowth and young saplings, and in feeding it reaches to a considerable height, pulling down leafy twigs with its long prehensile tongue. It does not, I think, feed at night, but in the early evenings and the mornings until at least as late as nine or ten o'clock. It is not a jungle-loving animal at all, but prefers the higher and drier parts of the forest, where the trees are big and the undergrowth comparatively scanty. It has no skulking bongo-like habits, but is never seen in the open. When going away at speed its neck is held straight in front, and it will jump obstacles rather than go beneath them, like the bongo and the little red buffalo.

Everything points to the okapi being the progenitor of the giraffe, or at least there seems little doubt that both are from the same stock. The okapi certainly does not appear to me to have any affinities with the antelopes.

CUTHBERT CHRISTY.

Royal Societies Club, St. James's Street, S.W.,
May 24.

A Further Extension of the Spectrum.

IN NATURE of May 7, 1914 (vol. xciii., p. 241), I stated that I had extended the ultra-violet limit of the spectrum to the neighbourhood of wave-length 900 Ångström units.

I have now succeeded in carrying my observations to wave-length 600. This result is chiefly due to the use of helium of considerable purity in my spectroscope and discharge tube. The apparatus is the same grating vacuum instrument which I have employed for several years, but perfected in such a way as to make it much more nearly air-tight than ever before. The spectrum which is obtained with a disruptive discharge in helium contains, between wave-length 1250 and 600, upwards of fifteen lines, some of them of some strength.

My work with hydrogen confirms the existence of the series predicted by Ritz with members at 1216, 1026, and 972. But, owing to the great difficulty of obtaining the gas content of my spectroscope absolutely free from impurities, I am not even yet able to identify positively the source of certain strong lines which occupy the positions demanded by the analogue of the Pickering series, and occur both when hydrogen and when helium are employed.

THEODORE LYMAN.

The Jefferson Laboratory, Harvard University,
May 11.

The Distribution of the Electrons in Atoms.

THE spectra which are obtained by the diffraction of X-rays by crystals are characteristic both of the substance which emits the X-rays and of the crystal which acts as the grating. If the lines of an accurately ruled plane grating are small in width compared with their distance apart, the intensities of the different orders of spectra are nearly the same. If, however, the lines have a width comparable with the grating constant, the intensities of the higher orders rapidly diminish. When a crystal diffracts a beam of X-rays, the different layers of atoms correspond to the lines of the ordinary transmission grating, so that the relative intensity of the higher orders of spectra will depend upon the ratio of the effective diameter of the atoms in scattering the X-rays to the distance between the successive layers of atoms.

There are good reasons for believing that it is the electrons in atoms which scatter the X-rays. On this assumption it may be shown that if the density of the space distribution of the electrons in each layer of atoms is some function $f(z)$ of z, where the z axis is taken normal to the reflecting planes, the ratio of the amplitude of the nth order spectrum to the amplitude it would have if all the electrons were in the same plane is:—

$$\frac{P}{P_0}=\frac{\int_a^b f(z)\cos(\beta+2\pi nz/d)dz}{\cos\left(\beta+\pi n\frac{b+a}{d}\right)\int_a^b f(z)dz},$$

where $b-a=d$ is the grating space, and β is the phase angle of the reflected ray. If it is possible to find some function $f(z)$ which will lead to the values of P/P_0 as determined experimentally, an indication will be obtained of the distribution of the electrons in the atoms.

W. H. Bragg has published experimental results (*Phil. Mag.*, vol. xxvii., p. 895, 1914) showing the rate of variation of the intensity with the order when X-rays are reflected from rock-salt. It can be shown from his data that the intensities of the different

orders cannot be accounted for by assuming that the atoms in the salt crystal are made up of single rings of electrons, or by assuming a uniform volume distribution of the electrons in spheres. A distribution which fits Bragg's data acceptably is an arrangement of the electrons in equally-spaced, concentric rings, each ring having the same number of electrons, and the diameter of the outer ring being about 0·7 of the distance between the successive planes of atoms.

If, as D. L. Webster assumes (*Phys. Rev.*, vol. v., p. 238, 1915) the trains of waves of the primary beam of X-rays are short compared with the distance which the rays penetrate the crystal, certain corrections have to be applied to the experimental data, and on this assumption it can be shown that the average distance of the electrons from the centre of the atom is small compared with the distance between the atoms.

Experiments are now in progress to test the validity of Webster's assumption and to determine more accurately the rate of variation of the intensity of the reflected beam with the order. It is hoped that it will be possible in this manner to obtain more definite information concerning the distribution of the electrons in the atoms. ARTHUR H. COMPTON.

Palmer Physical Laboratory, Princeton, N.J., April 29.

I HAVE to thank the Editor for his kindness in allowing me to see Mr. Compton's letter. I believe Mr. Compton is right in ascribing the rapid decline in the intensities of the X-ray spectra as we proceed to higher orders to the fact that the atom should not be treated as a point, but as a distribution of electrons in space; if this is so, we may hope to determine this distribution when we have measured the relative intensities accurately and have learnt to interpret them. This hypothesis and its consequences were discussed by me in the Bakerian lecture given before the Royal Society in March last. As only short notices of the lecture have yet appeared in print, I may mention one or two of the points then raised.

It seems convenient to imagine a periodic distribution of density such as occurs in a crystal to be analysed by Fourier's series, in a manner suggested by previous work of Rayleigh, Schuster, or A. B. Porter (*Phil. Mag.*, January, 1906, p. 154). Each harmonic distribution of density is responsible for one order of reflection. The results of measurements with calcite seem to show that the intensity (not the amplitude) of the reflection by a "harmonic reflector" is proportional to the amplitude of the harmonic distribution of density; that is to say, that the intensity of the reflection is proportional to the mass of the reflector. It is necessary to explain, not only why the intensities of the various orders fall off approximately as the inverse square of the number of the order, but also why atom-bearing planes give intensities whose reflections are proportional to the squares of the distances separating the planes. It appears that both laws follow from the same hypothesis, viz. that which supposes the reflecting electrons to be distributed in space through the volume of the atom, and which imagines much overlapping to take place—atoms of one plane being thrust far into the interstices of the next.

Experiment seems to fit in with these ideas. Probably, however, it is necessary to take account also of a difference in the distribution in different atoms. For example, certain results seem to indicate that the sulphur atom is more concentrated than the zinc.

The University, Leeds. W. H. BRAGG.

Early Figures of the Remora.

As remarked by Dr. Albert Günther, in his article on the history of the Remora ("On the History of the Echeneis," *Ann. Mag. Nat. Hist.*, 1860, ser. 3, vol v., p. 386), "there is scarcely a fish of the existence of which the ancients have been equally certain, and which has so much occupied their imagination . . . as the Echeneis of the Greeks or Remora of the Latins." Also, the same author continues, "there is scarcely a group of fishes . . . which has been so little *comparatively* treated, and which has experienced a similar splitting up into nominal species."

The ancient legends associated with this fish, from which it derives its name, signifying "ship-holder," persisted until well into modern times; and what is probably the earliest illustration of the Remora in printed books shows several of these creatures engaged in arresting the progress of a vessel. The curious woodcut referred to is found in that late fifteenth-century work known as "Hortus Sanitatis," the author or compiler of which styles himself Johannes von Cube, or Cuba, by some thought to have been a punning pseudonym for Dr. Wonnecken, town

FIG. 1.—Earliest known printed figure of the Remora, from the "Hortus Sanitatis" of J. von Cube.

physician of Frankfort. First printed about 1490, the work enjoyed considerable popularity, as is proved by its having passed through several editions. A copy of the design representing the Remora, taken from the 1536 edition, is shown in Fig. 1.

The next oldest illustration of the Remora appeared in a book, or perhaps a map, printed during the first half of the sixteenth century, and was copied by Conrad Gesner in book iv. of his "Historiæ Animalium," published in 1558. It is shown in Fig 2. The same figure, more or less modified, reappears in various seventeenth-century works on natural history, as, for example, those of Nieremberg, Aldrovandi, Jonston, Ruysch, and others.

Search for the original after which Gesner's figure was copied has proved unavailing; but the subject of the sketch, and also the verbal description, are traceable to the account of a West Indian species of sucking-fish, the first printed description of which is found in the "Libretto" of Peter Martyr of Anghera, published in 1504, and reprinted three years later in the collection of voyages known as "Paesi novamente Trovati."

The source of Peter Martyr's information was undoubtedly Columbus himself, for we find the same fishing incident related, together with a more trustworthy description of a species of sucking-fish (probably *Echeneis naucrates*), in those fragments of the Journal of the second voyage of the great discoverer which have been preserved by his son Ferdinand, and by the chroniclers Bartolomé de Las Casas and Fray Andrés Bernádez.

Bernáldez, curate of Los Palocios, was a personal friend of Columbus, and had access to his Journals and other papers. Thirteen chapters of his history are devoted to the Admiral and his discoveries. In chapter 126 occurs an interesting passage relating to the Remora, which no doubt faithfully reproduces the famous navigator's own words. The only naturalist of modern times who has commented upon the incident in question, so far as the present writer has been able to find, is Alexander von Humboldt. Poey briefly refers to it in his description of the so-called *Echeneis guaican*, and Dr. Günther appears to doubt that the Remora was actually employed in the capacity narrated.

The passage in Bernáldez reads :—

"[At the Queen's Gardens, off the coast of Cuba] on the day following [May, 1494] the Admiral being very desirous to find someone from whom he might obtain information, there came a canoe to hunt for fish :—for they call it hunting, and they hunt for one fish with another. They have fishes of a certain kind which they hold by a line fastened to their tails, and which are like the conger-eels in shape; and have a large mouth armed with suckers, like the cuttle-fish. They are very fierce, like our ferrets, and when they are thrown into the water, they go to fasten themselves upon some of the fishes there, and sooner die than let go their hold, till they are drawn out of the water. The fish is very light, and as soon as he has taken hold, the Indians draw him by the long cord tied to his tail, and immediately throw him into the water again; and in this way, they take one every time. As these hunters were at a distance from the caravel, the Admiral sent his armed boats to them, contriving it so that they should not escape to land. As the boats came up to them, these hunters called out to the men, as unconcernedly as if they had known them all their lives, to stop, because one of the fishes had fastened upon a large turtle, and they must wait till they had got it into the canoe.

"This our men did, and afterwards they took the canoe, and those in it, together with four turtles, each of which was three *codos* long, to the ships of the Admiral; and there they gave some account of these islands, and of their cacique, who was close at hand, and had sent them to hunt. They asked the Admiral to go on shore, and they would make for them a great feast, and would give to them all four of the turtles."

C. R. EASTMAN.

American Museum of Natural History, New York.

FIG. 2.—The Remora or "Reversus" as described by Christopher Columbus. (After Conrad Gesner, 1558.)

A Mathematical Paradox.

"Two horses, side by side and four feet apart, run once round a race track. How much further does the outer horse go than the inner?"

If this question is asked, in nearly every case the immediate reply is that it depends on the size of the track. It is somewhat paradoxical that the distance is 8π, or a little more than 25 ft., is actually independent both of the size and of the shape of the race track, provided that there is no reversal of curvature.

This problem is stated in a more formal manner in Williamson's "Integral Calculus," namely, if two curves have the same evolute the difference of their lengths is $4\pi D$, where D is the distance between the curves.

A. S. E.

A Mistaken Wasp.

THE mistake made by the cabbage butterfly referred to in NATURE of May 20, appears to be made by other insects.

Quite recently (last week in April) whilst having lunch in a sunny room decorated with a light-coloured paper with a floral design of pink roses in full bloom, a large wasp entered and became very agitated; observing it for some little time, I noticed it alight every moment or so in the centre of one of the roses, remain a moment, then off again to another; it appeared to be getting very angry as it went from rose to rose, which it kept on doing during the time I was in the room—twenty minutes or so.

W. A. GUNN.

Corporation Museum and Art Gallery, Dock Street, Newport, Mon., May 22.

THE PENGUINERY RE-VISITED.[1]

THE author's fascinating popular account of the social life of the Adélie Penguin (*Pygoscelis adeliae*) has been already reviewed in these columns, but the subject is of such great interest and Dr. Levick is such a consummate observer that we make no apology for turning to this second and more formal publication in the hope of adding to the completeness of the picture previously presented.

Apart from the observations made by the late Dr. Edward A. Wilson, which may be accepted, we are told, as "entirely correct," previous descriptions of the life of the Adélie Penguins have failed to do justice to these wonderful birds. About the middle of October they appear in ones and twos on the beach at Cape Adare, and by the end of the month there may be three-quarters

[1] British Museum (Natural History). British Antarctic (*Terra Nova* Expedition, 1910. Natural History Report. Zoology. Vol. i., No. 2. "Natural History of the Adélie Penguin." By Staff-Surgeon G. Murray Levick. Pp. 55-84+plates i-xxi. (London: British Museum (Natural History), and Longmans, Green, and Co., 1915.) Price 5*s*.

of a million (Fig. 1). They toddle along on the sea-ice at the rate of about two-thirds of a statute mile per hour, with about 130 steps to the minute, and this mode of progression they alternate with tobogganing on their breasts, using their legs as propellers (Fig. 2).

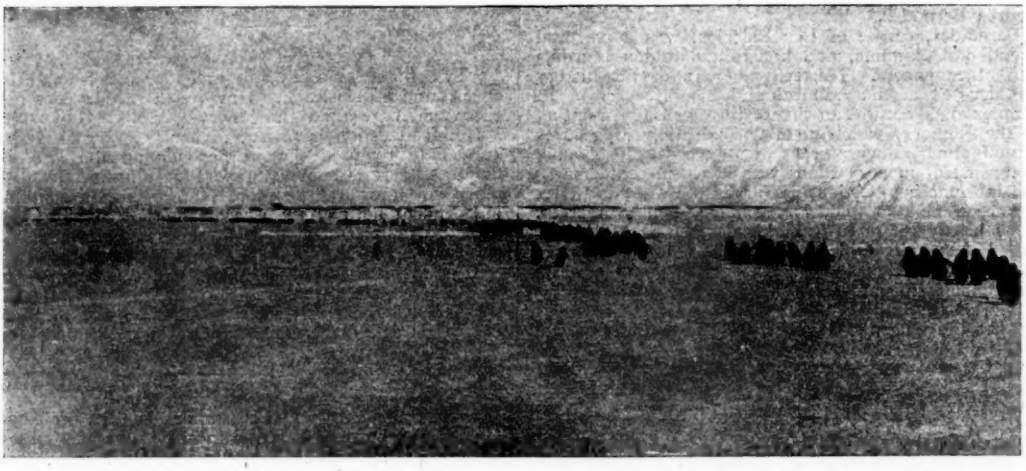

FIG. 1.—A long line of Adélie Penguins approaching their breeding ground. From "Natural History of the Adélie Penguin."

Some of them stop on the low ground; others make straight for the cliffs and nest on the ledges. Dr. Levick found a colony established at the very summit, about 1000 feet above the sea, a site that involved a prodigious amount of labour later on when the young had to be fed. Several journeys up and down had to be made in the twenty-four hours, and the up-journey meant about two hours' strenuous climbing. Very interesting in its prescience was the entire avoidance of an attractive knoll rising out of a shallow lake near the beach. It was very suitable when the penguins came ashore, but later on it was surrounded by foul water slimy with guano, to wading in which the birds have a deeply-rooted objection. But how did they know? Another interesting fact was the occasional raising of nests which had been built too low, and were in danger of being flooded in thaw time.

In connection with the mating, with its deadly but never fatal encounters of rival cocks and the quaint approaches that the victor makes to the coy hen, the observer proved by marking the breasts with paint that couples remain perfectly faithful to one another all through the breeding season. Careful watching of marked nests showed that the shortest period of fasting (between the arrival at the rookery and the hatch-

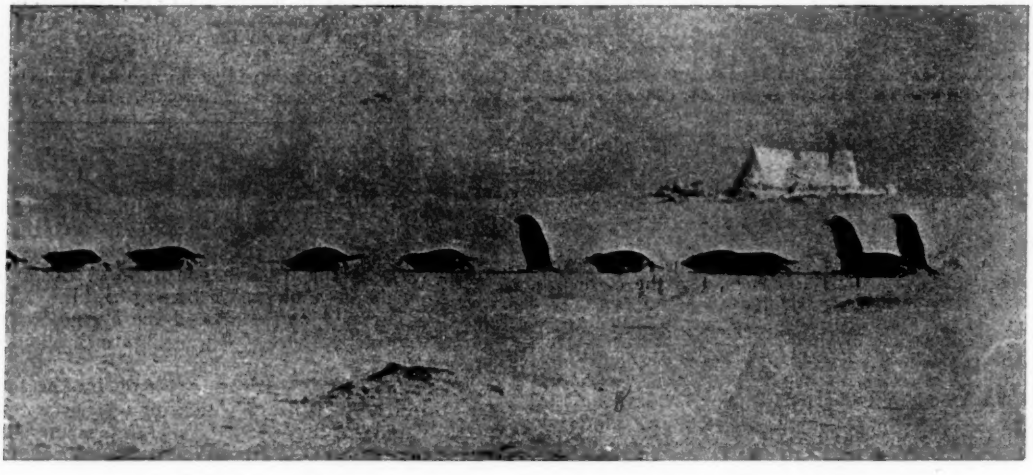

FIG. 2.—Adélies walking and "tobogganing" over sea-ice to the Rockery. From "Natural History of the Adélie Penguin."

ing of the chicks) is about eighteen days, and the longest about twenty-eight days. The reason for the close-sitting is to guard the stones of the nest from being stolen, and to guard the young wives from the attentions of strange cocks. Consequent on the abstinence from food the excreta around the nest are bright green—the colour of the bile, and without the red guano which is deposited after the birds begin to feed. They depend solely on euphausias, somewhat prawn-like crustaceans rich in zoonerythrin.

When the eggs are laid one of the parents goes off for some days (up to seven or ten), and on its return the other partner has a similar respite. When the chicks are hatched the alternations are frequent. Very quaint is the way in which the parents often overload themselves with the euphausias with which they feed the young, so that they have to lean back to keep their balance. Sometimes the toil is too much for them, and they lose all their take and all their trouble at the last moment. For the chicks will not pick anything off the ground, or eat save in the proper way by thrusting their heads down their parents' throats.

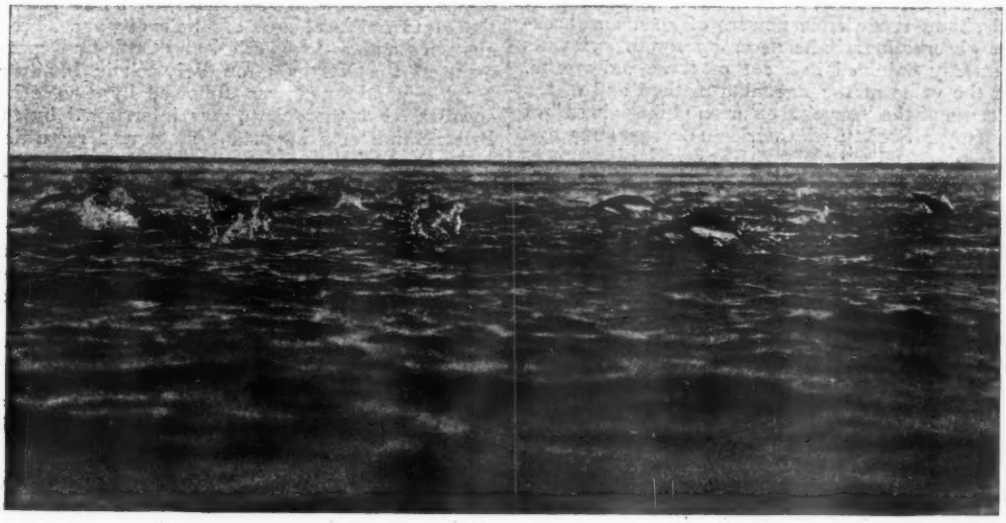

FIG. 3.—Adélie Penguins "porpoising." From "Natural History of the Adélie Penguin."

The rate of growth is astonishing. Thus the egg weighed 4·56 ounces, the newly-hatched chick 3 ounces, the five days' old 13 ounces, the six days old 15·75, the eight days old 24·75, the nine days old 28·5, the eleven days old 37·75. When the chicks are about a fortnight old the parents "pool their offspring," leaving them in the care of domesticated individuals, while they enjoy themselves holidaying in the sea (Fig. 3) or on the ice. Of their "touch-last" and "excursion steamer" games, of their mortal fear of the voracious sea-leopard (*Hydrurga leptonyx*)—their only enemy in adult life save man and his dogs, of the high mortality among the young for which the voracious skuas and the vicious cocks are largely to blame, of the "ecstatic attitude" and "chant de satisfaction" which mark a high sense of well-being among the Adélies; of the toughness of the birds, seen, for instance, in their surviving being imprisoned for weeks in a superficially frozen snow-drift; of the puzzling "drilling on the ice," which may be a reminiscence of massing before migration; and of the autumnal farewell to the antarctic shores and the journey to unknown winter-quarters, the report itself must speak. The author has our felicitations.

THE ANTIQUITY OF HINDU CHEMISTRY.

THE *Panjabee* of February 23 contains a report of a lecture on the antiquity of Hindu chemistry, given before the Punjab University, Lahore, by Dr. P. C. Rây, of the Presidency College, Calcutta, which is of interest as demonstrating the origin of Indian chemistry and the influence of Hindu learning upon that of the Arabs and of European nations. Two thousand five hundred years ago the Hindus were skilled in the examination and valuation of gold and gems; in a knowledge of the colouring of gems and jewels, and in certain metallurgical processes. Long before the age of Paracelsus they recognised that chemistry was the handmaid of medicine, and that its development was intimately bound up with progress in the art of healing. As with the Iatro-chemists, Hindu chemistry became, for a time, the chemistry of mercury. In the *Sarvadarsansamgraha* of Madhavacharyya the chemistry of mercury ranks, indeed, as a separate system of philosophy. "By the science of mercury is to be understood not only a branch of chemistry, but as applicable even to salvation, since the partaking of mercurial preparations renders the body imperishable." From

which we may infer that the Hindus were aware not only of the therapeutic virtues of mercurials, but had recognised their remarkable antiseptic and preservative properties. In fact, according to Dr. Rây, the history of Hindu chemistry is emphatically the history of the progress of chemical operations grouped round the preparations of mercury. So much is this the case that in ascertaining the age of a medical work or of a chemical Tantra it may be laid down as a fairly safe guide whether any mention of the use of mercury occurs in it, and, if so, in what particular form.

Dr. Rây gives a number of instances in which discoveries usually considered of Western origin are to be found noted in old Hindu treatises, such as those of Vrinda and Chakrapani. The Tantra, the "Rasarnava" (about 1200 A.D.), is a repository of chemical lore, with elaborate directions and details of the construction of apparatus, furnaces, hearths, etc., required for distillation, sublimation, calcination, extraction of metals, etc., and shows remarkable powers of keen and accurate observation, The necessity for experiments is strictly enjoined in most of these old works, and the value of the Baconian method and of the precepts of the "experimentarian philosophers" of the Royal Society of Charles II. was long ago recognised and appreciated by their Indian predecessors. Even the influence of the experimental method on teaching was not lost sight of. "They alone," says Dhundhukanatha, "are to be regarded as real teachers who can show by experiments what they teach. They are the deserving pupils who, having learned the experiments from their teachers, can actually perform them. The rest, both the teachers and pupils, are merely stage actors."

Verily one generation passeth away and another generation cometh, and there is no new thing under the sun. T.

THE SUPPLY OF OPTICAL GLASS AND INSTRUMENTS.

OPTICAL matters, and technical education generally, continue to claim their share of public attention. Following upon the article which appeared in our issue of May 6 (p. 266) on the supply of optical glass, we had the important debate, published verbatim in our last issue, on the proposed Advisory Council on Industrial Research which arose on the education estimates. More recently, on the motion for the Whitsuntide adjournment on May 19, an important speech, which was entirely devoted to optical matters, was made by Sir Philip Magnus. The speech, so far as it related to the supply of optical glass, necessarily traversed the ground covered by our article of May 6, but added specific instances of the German "wire entanglements" woven round the optical trade.

The speech, however, went further, and dealt with the supply of optical instruments, treating in detail the economic and educational aspects of the question. On the economic side it was laid down as an axiom "that what is essential to the safety of the realm must be produced within the Empire." The questions of high tariff and of a bonus on production were referred to, but the suggestion most favoured advocated that it be an enforced condition of all Government contracts that every part of the optical instruments contracted for should be made in this country. With the Government trade thus secured, it was argued that German attempts to capture the whole industry must fail.

On the educational side, the country's requirements, which are well known to our readers, were summarised, but perhaps too little was made of the necessity, which is strongly supported by leading experts, for the provision of, at least, one place where the whole range, from the lowest to the highest, of teaching in applied optics shall be available. The final suggestion made was "that a small committee should be appointed to co-ordinate the work of" the National Physical Laboratory, the Imperial College of Science and Technology, and the Technical Optics Department of the Northampton Polytechnic Institute. Sir Philip Magnus was followed by two other speakers, but the debate was interrupted by the Prime Minister's important statement regarding a Coalition Government.

Later on, Dr. Addison replied sympathetically on behalf of the President of the Board of Trade, and assured the House that the "subject was being closely attended to, and that the Government hoped at a very early date to have a comprehensive scheme to deal with this somewhat complicated and technical question."

NOTES.

We regret to announce the death, on May 23, at eighty-one years of age, of Dr. Hugo Müller, F.R.S., past-president of the Chemical Society.

THE death is announced, in his seventy-first year, of Dr. Joseph J. Hardy, who had held the chair of mathematics and astronomy at Lafayette College, Pennsylvania, since 1891. He was the author of "Analytic Geometry, Infinitesimals and Limits."

THE Paris correspondent of the *Times* announces the death of M. Pierre Martin, the inventor of the Martin process of steel manufacture. It was only last week that we announced that the Iron and Steel Institute had just conferred on M. Martin the Bessemer gold medal for 1915.

THE deaths are announced in *Science* of Prof. J. W. Seaver, for twenty-five years director of the Yale gymnasium, and professor of hygiene in the University, on May 5, at the age of sixty years, and of Mr. W. H. Reed, curator of the museum and instructor of geology in the University of Wyoming, noted for his collections of vertebrate fossils, who died at the age of sixty-seven years on April 24.

THE Albert medal of the Royal Society of Arts for the current year has been awarded to Sir J. J. Thomson, for his researches in physics and chemistry, and

their application to the advancement of arts, manufactures, and commerce. The Albert medal was founded in 1863 to commemorate the Prince Consort's presidency of the society, and is awarded "for distinguished merit in promoting arts, manufactures, and commerce."

DR. E. O. HOVEY, of the American Museum of Natural History, has just returned from a three months' expedition to the Lesser Antilles. The time was largely given to an examination of Mont Pelée, the Soufrière, and other volcanoes of this region. It is reported by Dr. Hovey that the activity of Mont Pelée has continually diminished since the great outbursts of 1902–3. On the east or windward side vegetation has re-established itself up to the very summit, and even the forest is beginning to reassert itself. The rocks of the new cone are more or less thickly coated with moss.

WE announced last week the award, by Columbia University, of the Barnard gold medal to Prof. W. H. Bragg and his son, Mr. W. L. Bragg, for their researches in molecular physics and in the particular field of radio-activity. The Butler gold and silver medals have also been awarded. The gold medal is awarded every fifth year for the most distinguished contribution made during the preceding five-year period to philosophy or to educational theory, practice, or administration. The silver medal is awarded annually to that graduate of Columbia University who has, during the year preceding, shown the most competence in philosophy or in education theory, practice, or administration, or has during that time made the most contribution of any of these. The former has been awarded to the Hon. Bertrand Russell, lecturer and fellow of Trinity College, Cambridge, for his contributions to logical theory. The silver medal has been awarded to Prof. E. P. Cubberley, of Leland Stanford Jr. University, for his contributions to educational administration.

A SUGGESTION for the defence of our soldiers against poisonous gas in the present war is made by Dr. F. C. Coley, of Newcastle-upon-Tyne, in a letter to the *Morning Post* of May 25. He proposes the use, in the trenches near enough to the enemy to be in danger from such gases, of rotary fan-blowers worked by hand placed at about every three or four yards. The fan-blowers should be connected with pipes going through the base of the earthwork in front of the trench. If the number of blowers were equal to the number of gas cylinders used by the enemy, the blowers when vigorously worked would deliver a far greater volume of air than the volume of the poisonous gas, so that the gas would become much diluted, and with good respirators would be harmless to our men. We believe that experiments are being conducted at the front with the object of devising means to render the poisonous gases innocuous by spraying with water and in other ways. The former expedient would require only a supply of water in the trenches and a spraying apparatus, and it would seem to afford an effective means of protection.

MR. RICHARD KERR, the genial and well-known lecturer on astronomy, microscopy, and other scientific subjects, died on May 19, at sixty-five years of age, after suffering greatly from a complication of disorders. For the last two years he had shown signs of breaking down in health, partly owing to anxiety and the difficulty of getting and fulfilling a sufficient number of engagements to keep him fully employed. He leaves a widow and a family of four. About twenty years ago he was associated with such men as Huxley, Sir B. W. Richardson, and Lant Carpenter in the work of the Sunday Lecture Society, and he was well known at the leading literary and scientific institutions in London and the country as one of the most popular exponents of science. His pleasant and easy manner, with occasional gleams of Irish humour, made him welcome to his audiences. He was the author of many books and articles on the popular side of science, such as "The Hidden Beauties of Nature," "Nature, Curious and Beautiful," and "Wireless Telegraphy Popularly Explained." He had also two or three books ready for publication, but on account of the war he found it impossible to get them published. He was an artist of no mean merit, and drew the illustrations for his books and lantern-slides with his own hand. His ability was recognised by the Home Office, who employed him as a lecturer to H.M. Prisons.

IT is proposed to found a memorial in honour of the late Mr. E. T. Busk, who met his death in November last at Aldershot while flying his own stable aeroplane, owing to its destruction by fire, thus terminating a career already marked by fine achievement and full of promise for the future. At Cambridge he took first class honours in the Mechanical Sciences Tripos, and was awarded the John Wimbourne prize and a scholarship at King's College. After passing some years as an engineer, he joined the staff of the Royal Aircraft Factory, where he devoted his time especially to the mathematics and dynamics of stable flight of the full-size aeroplane, to researches into the nature and cause of wind gusts, and to the uses of aircraft in warfare for offensive and defensive purposes. Besides this work, he was entrusted with the general control of the chemical, metallurgical, and physical research and test work at the factory. The memorial will consist of (1) a studentship to enable a student to carry on some research in aeronautics or a kindred subject, and (2) a lecture on some such subject to be given annually by the holder of the studentship or by some other lecturer, and to be published in the *Aëronautical Journal*. Subscriptions to the amount of about 2500*l*. have been received or promised, and further contributions will be gratefully acknowledged by Sir Edward H. Busk, 11 Sussex Place, Regent's Park, N.W., or the secretary of the Aeronautical Society of Great Britain, 11 Adam Street, Adelphi, W.C.

ACCORDING to a "neutral" correspondent of the *Times*, the Germans are busy with the preparation of smoke bombs to be dropped from Zeppelins when the long-talked-of air-raid on London takes places. We are told that an eye-witness saw the smoke cloud

spread over an area of several kilometres! There is little difficulty in constructing a bomb which shall explode at a given distance above the ground and produce a dense cloud, but it is doubtful whether such a smoke cloud could be made to spread over anything like a distance of kilometres. We are told further that these bombs will prevent attack by anti-aircraft guns and aeroplanes. How it is to stop the latter, which travel at a much higher speed than a dirigible, and will certainly attack from above or at least on a level with the Zeppelin, is not clear. In the absence of any dissipating wind a Zeppelin free to choose her course may derive considerable advantage from a smoke bomb burst over a gun position, but some shots should certainly be fired before she has time to locate the gun, and then she must get well over the position to place the bomb effectively. Smoke is a very vague term, and whilst it may obscure physical vision may also be used to cover something far more dangerous. In this connection the warning issued by the Commissioner of Police to keep all windows and doors on the lower floors of houses closed, in the event of an air-raid, to prevent the access of deleterious gases is not without significance, and should certainly not pass unheeded.

THE service of radio time signals which is now provided by the Union Government wireless telegraph stations at Cape Town (Slangkop) and Durban will be of inestimable value to shipping in South African waters. By means of such a service, vessels within range of the stations can ensure a precision of standard time which it would otherwise be impossible for them to obtain, and the new facilities should make for added safety in navigation. The Cape Town (call letters VNC) and Durban (VND) stations are open night and day, and work on a 600-metre normal wave. A special clock at the Cape Town Observatory is adapted to give automatically a series of signals extending over an interval of half a minute. The signals are transmitted at 11 p.m. Union time, which is equivalent to 9 p.m. Greenwich mean time, and shortly before that hour the clock is brought into conformity daily with the observatory standards. The time signal proper, which is preceded by the usual warning signal, consists of twelve dashes, each of about three-quarters of a second in duration, divided into five groups, the commencement of the separate dashes corresponding exactly with the following Greenwich mean times:—

Group I. h. m. s.	Group II. h. m. s.	Group III. h. m. s.	Group IV. h. m. s.	Group V. h. m. s.
8 59 30	8 59 38	8 59 44	8 59 48	8 59 54
8 59 32	8 59 40		8 59 50	8 59 56
8 59 34				8 59 58
				9 00 00

By means of a special relay the time signal is simultaneously transmitted to the Cape Town and Durban wireless stations, the signal to the latter station passing over the land telegraph wire connecting Cape Town and Durban, a distance of about 1100 miles. In addition to the time signals, both stations transmit each day, at 1 p.m., a report in plain language containing information concerning the meteorological conditions prevailing on the whole coast of the Union of South Africa.

THE *Popular Science Monthly* for April contains a series of fifteen short articles dealing with American economic and social problems arising out of the war. Stress is laid primarily upon the necessity for the education of the American people in methods of maintaining health and prolonging life; it is shown that "degenerative diseases" are causing an increased death-rate which was nearly doubled between 1880 and 1910. The average man is not an able-bodied citizen; he is far below the attainable standard of physical soundness and efficiency. The war appears to cause the American to look more closely upon the value of a human life. A second point arises out of a consideration of the American mercantile marine. The merchant navy of the United States is totally inadequate to the carrying of more than one-tenth of the American trade. Americans are advised to seek for foreign trade with the same energy as they display in capturing markets in distant parts of the United States, and the Englishman is amused to learn that the American exporter is suspected of bad packing, lack of adaptability, and the dozen or so other faults which are alleged to be manifest among English exporters. Taken as a whole, the series is symptomatic of the stimulus which results from war; nothing can be quite the same again; distant America will share with the rest of the world in the changes, and notable Americans here display the tendency of their thoughts. The occasion for these articles was the meeting of the American Association for the Advancement of Science in December last.

THE Zoological Society of Philadelphia is to be congratulated, since, according to its forty-third annual report, among a consignment of young bears, shipped from Europe as "Russian bears," two, a male and a female, prove on examination to be specimens of the rare blue bear of Tibet (*Ursus pruinosus*). The pathologist's report contains some valuable data on tuberculin tests, carried out on monkeys and birds, on enteritis among quails, and on larval and adult hook-worms, which were the cause of considerable mortality among the Canidæ during the year. Perhaps the most important parisitological item of the year was the discovery of cysts of *Coccidium bigeminum* in the fæces of a fox. This parasite has been found three times in man, and frequently in dogs, but it has never before been found in a wild animal.

MANY items of more than usual interest are to be found in the Report of the South African Museum for 1914. In the first place, the director, Dr. Louis Péringuey, is able to state that the agitation, started some time ago in the Uitenhage district, for the destruction of the elephants in the Addo Bush, has not only failed, but that the Provincial Government is taking steps to ensure the safety of the three troops known to occupy the preserve. The herd apparently will have to be thinned, but no indiscriminate shooting will be allowed, and provision will be made for ensuring to the remainder a fair supply of water, the lack of which is oftener than not the cause of the

animals' so-called depredations. The "wiping-out" of the herd, said to number 300 head, is no longer to be feared. Among the additions made to the collections during the year he directs special attention to "two extraordinarily large vessels affecting the shape of a hippopotamus" from southern Rhodesia. These bear a striking resemblance to the work characteristic of the early Egyptian civilisation, and afford a parallel to the large soap-stone bowls found at Zimbabwe by Bent, and the similar bowls used as fireplaces or ovens, found at Meroë and Abydos, close to the oldest known temples of Osiris.

A REPORT has recently been issued by the Fisheries Branch of the Department of Agriculture and Technical Instruction for Ireland on the outbreak of the disease known as "furunculosis," which attacked the salmon in the river Liffey in 1913. The report (Fisheries, Ireland, Scientific Investigations, 1914, ii. (1915), price 4*d*.) is by Prof. A. E. Mettam of the Royal Veterinary College, Dublin. After giving a useful summary of previous literature dealing with the disease, the author records the results of careful microscopical and bacteriological examination of a number of diseased fish. Attention was first prominently directed to the disease in Great Britain by outbreaks which occurred in 1911 in the Wye, the Exe, the Teign, and the Dart, large numbers of salmon, trout, and other fish being found dead in these rivers. The epidemic was reported on by Dr. A. T. Masterman, of the English Board of Fisheries. Prof. Mettam confirms the accounts given by previous workers. The diseased fish, which may or may not show external boils or lesions, are infected by a micro-organism (*Bacillus salmonicida*) which occurs in immense numbers in pus from the boils and also in the blood. Infection takes place very rapidly through the skin or gills, or from infected food. Healthy fish placed in infected water often succumb within a few days. It is suggested that a river may become infected by fresh-run salmon from the sea. All that can be suggested to check the disease in a river is the immediate removal and destruction of all dead and dying fish. Care should also be taken not to transfer fish or fish fry from an infected river to one which is free from the disease.

IN Bulletin No. 19, issued by the North of Scotland College of Agriculture, Prof. James Hendrick describes the composition and value of liquid manure as produced under the farming conditions of the north-east of Scotland. It is well known that practically the whole of the potash and readily available nitrogen is found in the urine, and where the litter is unable to absorb this completely, the surplus drains to the liquid manure tanks. The practical difficulties in the way of utilising liquid manure to the best advantage have in the past led to a waste of valuable fertilising material. Since potash manures are practically unobtainable at present, any method of preventing waste of this element has a special significance. During four seasons, 1910–13, liquid manure was applied to grass-land on farms in the district at various times from December to March. In all cases there was a considerable increase in the hay crop from the manured land. The average value of the increase, where 2000 gallons of liquid manure per acre was given, was 25*s*. per acre, with hay at 51*s*. per ton. The objections of the practical man that liquid manure applied in mid-winter would be washed from the soil before the plant could make use of it were not borne out by these experiments, which showed that the increase of crop from land manured in December was as great as where the manure was applied in March. The analyses of the various manures showed that where the liquid was applied at the rate of 2000 gallons per acre, the application was equivalent to artificials costing about 2*l*. per acre. The great part of this value was recovered in the grass during the season of application.

IN the Annals of the South African Museum, vol. ix, part iv., Prof. Pearson continues the enumeration of the plants collected in the Percy Sladen Memorial Expeditions of 1908–9 and 1910–11 in South-west Africa. The various natural orders have been worked out principally by Miss R. Glover and Mrs. Bolus. Of the new species described and figured, *Nenax Dregei*, L. Bolus (Rubiaceæ), *Anticharis juncea*, L. Bolus, a spinescent scrophulariaceous shrublet from Great Namaqualand, *Agathosma Sladeniana*, R. Glover (Rutaceæ), and *Lotonotis exstipulata*, L. Bolus (Leguminosæ), from the Cape region, are some of the most interesting. In the same number Mr. Phillips described three new species of Proteaceæ.

THE report of the director of the Botanic Gardens and Government Domains, Sydney, New South Wales, contains an interesting account of the work done in the Botanic Gardens in particular, and includes a number of excellent photographs of various parts of these justly famed gardens. Following the example of Kew we are glad to notice that a list of the fauna of the gardens is being compiled, and a large number of different species are recorded in this report.

MR. E. D. MERRILL describes four new species of Dillenia and twelve of Saurawia from the Philippine Islands in the *Philippine Journal of Science*, vol. ix., No. 6. Some forty species of the latter genus are now known from the islands. One of the Dillenias, *D. cauliflora*, though collected as long ago as 1838 by Cuming, has only now been determined with the help of new material from the Island of Samar. The Cauline inflorescence is a very unusual character in this genus.

IN the *Philippine Journal of Science*, vol. ix., No. 6, Mr. F. C. Gates gives an ecological account of the swamp vegetation in hot springs areas at Los Baños, Laguna. Hot-water bacteria and Cyanophyceæ were found in the hottest water sometimes more than 56° C., and in the surface water up to 52° C. filamentous blue-green algæ were found. Bacopa and Lippia fringed the pools, and the critical temperature for their growth proved to be from 48°–52° C. Other plants are noticed in connection with their relation to the springs and the swampy ground and the associations which they form.

Tropical Life for April, 1915, contains an interesting letter entitled "The Future of the Solomon Islands,"

in which an account of the islands is given, and their importance for the production of copra is described. The soil is very fertile, volcanic in origin, mixed with coral limestone, and with the rainfall averaging 90–200 ins., and a very humid climate, the coconut palm flourishes and bears very heavy crops. Some 25,000 acres are now under coconut plantations in the various islands. The palms come into bearing very early, and the writer of the letter records that he saw a tree under six years old bearing considerably more than 300 nuts, which is by no means a record for these islands. As the Solomon group lies on the direct route between Australia and the Philippines and Japan, the importance of the islands is likely to increase in the near future.

IN the current number (vol. xiii., No. 1) of the Bulletin of the Imperial Institute attention is directed to the economic resources of the German colonies, and in particular to the agricultural and forest products of German East Africa. Copra, ground nuts, sesame seeds, oil palms, beeswax, cotton, coffee, grain, sugar-cane, and tobacco, all of which are in native hands, are among the products especially considered. The German East Africa Company also conducts a considerable sisal hemp industry—more than 367,000*l.* worth being exported in 1912—and there is extensive European cultivation of cotton, kapok, plantation rubber, and gutta-percha. The exports of the two latter products in 1912 reached the combined value of more than 362,000*l.* The bulk of the products went to Germany, but some of the rubber, coffee, copal, hides, and ivory have been coming to the United Kingdom.

THE *Kew Bulletin* No. 3 contains papers dealing especially with questions of systematic botany, including descriptions of several new species. In notes on South African Santalaceæ Mr. Hill describes three new species of the singular little dicœcious genus Thesidium. In some of the species the male and female plants are so dissimilar that unless found growing together, their relationship would not be recognised. A remarkable etymological invention originating with a misprint is pointed out in connection with the generic name Frisca, a synonym of Thesium, a misprint for *Th. Frisea*, a Linnean species of Thesium. Wettstein, in his "Etymologisch-botanisches Handwörterbuch," has "Frisca (Santalaceæ). Nach Th. Frisca, der sich am Cap im botanischen Interesse aufhielt." The mistake in spelling is due to Endlicher and Spach, but Wettstein is responsible for evolving from what is merely the name of a plant a person who in the interests of botany sojourned at the Cape.

DR. C. F. JURITZ, Government analyst, Cape Town, has recently visited the prickly pear station at Dulacca, Queensland, and contributed an interesting account of the prickly pear problem in Australia, which has been reprinted from the *Cape Times and Farmer's Record* for February 5. His account deals with the methods undertaken under the supervision of Dr. Jean White to eradicate the Opuntia and clear areas for cultivation. Of the two methods employed, the effects of chemicals and the introduction of cochineal, the former is likely to be more effective, since the insect has no effect on the most prevalent species, *O. inermis* and *O. aurantiaca*, which are protected by a layer of subcutaneous cells containing calcium oxalate. Of chemicals only those containing arsenic are of any practical value, and the effect of the gas arsenic trichloride appears to be very promising. The cost of destruction works out at about 15*s.* per acre. The use of the Opuntia as a source of potash and as a source of industrial alcohol promises some return on the outlay for destruction.

THE *Cairo Scientific Journal* for September, 1914, contains an extremely interesting and valuable discussion of "The Frequency of Cloud-forms at Helwan, 1904–1913," by Mr. N. A. Comissopulos. Helwan is situated about eighty miles west of Suez and about 130 miles south-east of Alexandria. The discussion is suggestive in its method and arrangement, and well deserves to be imitated by other observers. The times of observation are 8 and 11 a.m., and 2, 5, and 8 p.m. each day, and the clouds have been tabulated and classified to determine their annual and diurnal variations. Cirrus clouds are shown to be the most frequent of all clouds; they attain their absolute maximum in May and their absolute minimum in July, whilst the cirro-stratus attains two maxima during the year, in December–January and in April, and the absolute minimum is attained in September. Other upper clouds are somewhat irregular. Intermediate clouds, as alto-cumulus and alto-stratus, were rarely seen. For lower clouds it is mentioned that the progress of nimbus is regular, the maximum occurs in January and the minimum in July; stratus has two distinct maxima, one in April and the other in October, with an absolute minimum in June and July. Fogs occur principally in the early morning and during the winter months. Forty-nine per cent. of all observations are clear skies, which shows the relative dry character of the Egyptian weather. The grouping of the clouds for the diurnal variation also gives fairly regular results.

THE papers contributed to a general consideration of the hardening of metals, together with the discussion to which they gave rise at a recent meeting of the Faraday Society, of which an account was given in NATURE of December 3, 1914 (vol. xciv., p. 374), have been reprinted as a brochure by the society with certain additions. The latter include communications from Arnold, Rosenhain, and Thompson. The pamphlet thus gives in a compact form an up-to-date summary of the principal current theories of hardening. After reading it, it is impossible not to be struck by the far-reaching influence of Beilby's theory of the vitreous-amorphous and crystalline conditions of metals and alloys in its bearing on this question, in spite of the statement of Arnold that "no modern theories have disturbed to any great extent the explanation of the hardening of steel made by Henry Clifton Sorby a lifetime ago."

THE June and July, 1914, numbers of the *Journal de Physique*, which is now conducted by the French

Physical Society, have come recently to hand. In the former Prof. Lippmann describes a method of determining differences of longitude by taking instantaneous photographs of the stars at the two stations at the same moment. Prof. Bouty continues his examination of the fundamental assumptions of the kinetic theory of gases, and deals with the mean free path. M. J. Duclaux shows that the specific heats of a large number of organic liquids can be calculated directly from their chemical formulæ. The July number contains the lecture on photo-electricity given before the society in April, 1914, by Messrs. Pohl and Pringsheim. In addition to several shorter papers, the two numbers devote between fifty and sixty pages to abstracts of papers which have appeared elsewhere.

THE March issue of the *Presidency College Magazine*, Calcutta, contains a warmly appreciative article by Mr. F. V. Fernandes on the Indian School of Chemistry, with special reference to the work of Prafulla Chandra Rây and his pupils at the Presidency College. Prof. Rây is more particularly known to European chemists from his "History of Hindu Chemistry," and by his investigations on the inorganic and organic nitrites, a field of inquiry with which his laboratory has been specially identified, and with which certain of his pupils have been associated. Under the fostering influence of Principal James, Prof. Rây has gradually built up a distinct Indian School of Chemistry, and after centuries of scientific stagnation, India bids fair to recover something of her former position in the chemical world through the agency of the succession of pupils which have passed through his hands.

IN a recent number of the *Scientific American* (April 24, p. 379) a description appears of what is claimed to be the largest by-product coking plant in the world. Owing to the enormous natural fuel resources of the United States, economy in the use of fuel has received but scant attention. Future generations will have bitter cause for complaint about the prodigal waste of fuel by their ancestors; in no country more so than in that blessed with the greatest supplies. What this waste amounts to is now being realised, and in the production of metallurgical coke the lead of the Continent and Great Britain in the use of recovery plant is being followed. It is estimated that enough benzol to run 200,000 automobiles a year, and enough sulphate of ammonia to supply the farmers of the States with fertiliser for two years at the present rate of consumption, was thrown away in the waste gases of the beehive coke-ovens of the United States in 1912. Altogether the value of the by-products, had they been recovered, would have been about eighty million dollars. If the same amount of coal had been coked in retort ovens, more than five million more tons of coke would have been obtained. The new plant of the United States Steel Corporation comprises 560 ovens, and will produce 2,900,000 tons of coke annually. One hundred and twenty million cubic feet of gas will be obtained every twenty-four hours, half of which will be employed in heating the ovens, the other half for the corporation's steel furnaces. It is remarkable that this big plant is not equipped for the recovery of benzol. Owing to the native supplies of petrol, benzol as a motor fuel is not of that interest in the States which it is in Europe, especially at the present time; but even there benzol recovery will certainly soon become general, if only for the measure of independence it will secure against trusts and rings controlling the output of petroleum products.

"SANITATION IN WAR" is the title of a new book to be published about June 1 by Messrs. J. and A. Churchill, of 7 Great Marlborough-street, London, embodying lectures delivered by Major P. S. Lelean, assistant-professor of hygiene at the Royal Army Medical College. An introduction to the volume has been written by Surgeon-General Sir Alfred Keogh.

OUR ASTRONOMICAL COLUMN.

COMET TEMPEL 2.—A telegram from Prof. Strömgren, of Copenhagen, dated May 18, records the discovery of a comet by Delavan on May 16 at 20h. 52·2m. G.M.T. Its position is given as R.A. 0h. 33m. 1s., and declination -2° 5′ 31″ Its magnitude is not stated. From a communication to the *Morning Post* of May 20 the comet seems to be that of Tempel 2. It is there stated ". . . Tempel 2 has just been re-discovered by Delavan, who has been notably successful at La Plata in the last few years. The comet is probably not bright, and will very likely not be observed in this country, as it rises almost with the sun, and passed perihelion on April 14, only about one day from its predicted date. It is in a direction between the constellation of Pisces and Cetus. It was discovered by Tempel in 1873, and was observed in 1878, 1894, 1899, and 1904, so that three returns, including the last one, were not observed, its period being rather less than 5½ years."

OBSERVATIONS OF SATURN AT FLAGSTAFF.—Writing to the *Astronomische Nachrichten*, No. 4800, under dates March 11 and 18, Prof. Percival Lowell says (March 11):—"The crepe ring of Saturn has been observed and measured persistently wider on the east than on the west side of the planet during the past month by a difference of five-hundredths. This fact will have important bearings on the mechanics of the stability of the ring. Any phase effect or defect of illumination of the constituents of the ring are not sufficient to explain the phenomenon on account of the diminutive size of the meteorites composing it. A possible explanation of this detected eccentricity of the ring may be the revolution of the perisaturnium." Writing on March 18, he says:—"Photographs of Saturn taken on March 12 at this observatory, both by Mr. E. C. Slipher and the director, confirm visual observations in revealing that Cassini's division is visible in part above the contour of the ball by about four-tenths of its true width. This enables the oblateness of Saturn to be deduced from the photographs, a preliminary reduction of which shows that oblateness to be about one-ninth."

THE SPECTRUM OF THE INNER CORONA.—In the *Ofversigt af Finska Vetenskaps-Societetens Förhandlingar* (Bd. lvii., Afd. A, No. 25) Dr. R. Furuhjelm communicates a note on the spectrum of the inner corona. The photographs were secured by an expedition from the observatory of Helsingfors, which took up its position at Kumlinge, isles of Aland in Finland, for the observation of the eclipse of August 14 of last year. Details of the instrument used are given, but it may be stated that the size of the image falling on the slit was 36·4 mm., and the spectroscope was furnished with three prisms of angles of about

63° each; the spectrum, extending from λ 450–λ 590, measured 38·7 mm. The author directs attention to the peculiar form of the green ray in one part, indicating, as he says, a relation between prominences and the corona. In the determination of the wave-length of the green ray he deduces a value 5303·38±0·020, agreeing more closely with that of Campbell, namely, λ 5303·26, than that of Lockyer, λ 5303·7. For another line, behaving after the nature of the green ray, of which he determines the wave-length, he deduces the value λ 4566·81. Details of the researches he proposes to publish at a later date.

SPECTROSCOPIC ANALYSIS OF THE N'KANDHLA AND OTHER METEORIC IRONS.—Dr. J. Lunt describes in the *South African Journal of Science* (April, vol. xi., No. 7) a spectroscopic analysis which he has made of the N'Kandhla meteorite and of other meteoric irons. The spectra were photographed in the four-prism star spectroscope of the Victoria telescope of the Royal Observatory at the Cape, the spark being obtained between terminals of the meteoritic metal with an 18-in. coal and large plate condensers. The object of the research was to try to detect the presence of elements which might have escaped recognition in the previous chemical analysis, and to compare the composition of the N'Kandhla meteorite with that of four other meteoric irons, namely, the Great Namaqualand, Matatiele, Hex River, and Goamus. The result showed that cobalt, chromium, barium, and calcium were unmistakably present in the N'Kandhla, as well as in the other meteoric irons, though not detected chemically, and that no evidence was found of the presence of magnesium, platinum, and copper, traces of which were recorded in the chemical analysis. The non-metallic elements—carbon, sulphur, phosphorus, and chlorine—were recorded chemically, but furnished no spectroscopic evidence in the sparks, which were rich with the metallic elements. Dr. Lunt discusses in a series of paragraphs details with reference to the different elements found in these and other meteorites, and accompanies his paper with reproductions from strips of the spectrograms.

MEASURES OF SOUTHERN DOUBLE STARS.—The fourth series of measures of double stars is published by Mr. Innes in Circular No. 24 of the Union Observatory, the previous series having appeared in the Transvaal Observatory Circular, No. 13, and the Union Observatory Circulars, Nos. 4 and 14. The present series includes all pairs, more than 310 in number, for which satisfactory measures, equally divided between before and after meridian passage, have been made on at least two nights by the end of 1914. The telescope employed was the 9-in. Grubb refractor. A great many of the pairs were measured for the first time. The measures were for the most part made by Mr. Innes and Mr. Van der Spuy, but the latter left the observatory early in the year to join the Aviation Corps of the Defence Force, and afterwards was with the British Army in France.

MEASURING HEAT FROM STARS.—In this column for February 25 attention was directed to a paper by Dr. W. W. Coblentz on a comparison of stellar radiometers and radiometric measurements on 110 stars. In the May number of the *Popular Science Monthly*, under the title, "Measuring Heat from Stars," he describes in a very interesting manner early attempts at measuring stellar radiation, and the method employed by him at the present time. The article gives a good insight into the extreme delicacy of the investigation, the great progress that has been made in recent years, and the important outstanding problems which will no doubt be solved when the instrumental equipment has advanced a stage or two further.

RECENT WORK IN PALÆONTOLOGY.

C. D. WALCOTT, among his studies entitled "Cambrian Geology and Palæontology," treats of a "a pre-Cambrian Algonkian algal flora" (Smithsonian Miscell. Coll., vol. lxiv., No. 2, 1914). The horizon is that which has yielded the famous crustacean remains known as *Beltina danai*. The author urges that the abstraction of carbon dioxide from water by the action of blue-green algæ and bacteria, such as *Bacterium calcis* of the Florida Keys, is a potent factor in the precipitation of oolitic and other forms of limestone, and he freely quotes recent work, such as that of E. J. Garwood, in support. He regards the dolomitisation of the older limestones that may have been formed in this way as a secondary feature (p. 96). The author's remarks, in answer to G. Abbott, contributed to NATURE of December 31, 1914, may imply some reconsideration of the part played by inorganic concretion in the structures here described as various species of Newlandia. Collenia (p. 98) becomes separated from Cryptozoön, the latter being regarded as appearing for the first time in the Cambrian period.

G. R. Wieland has meanwhile published further studies on Ozarkian seaweeds and oolites (Bull. Amer. Mus. Nat. Hist., vol. xxiii., 1914, p. 237), dealing especially with Cryptozoön. He connects these Cambrian forms with the far smaller Girvanella, as a "homogeneous assemblage" of sea-weeds, and enters into a somewhat confusing argument as to whether their silicification occurred early or late in geological history. This leads on to a discussion of the associated beds of siliceous oolite, which are held to be primary deposits, and especially characteristic of early Palæozoic times (p. 255). The Jurassic oolites preserved in flint at Portland, and the siliceous residues of the oolitic grains of ferrous carbonate in the pseudomorphous ironstones of Cleveland, are English evidences against this contention. Both Wieland (p. 248) and Walcott threaten us with a re-opening of the Eozoön question on algal lines, despite the work of Gregory and Johnston-Lavis on the limestone blocks of Monte Somma and several publications on layer-structures from the osmotic point of view.

G. R. Wieland is associated with Marion G. Elkins in a paper on "Cordaitean wood from the Indiana Black Shale" (*Amer. Journ. Sci.*, vol. xxxviii., 1914, p. 65). The horizon is Upper Devonian, and the wood of the new species, *Callixylon oweni*, is exceptionally well preserved. From the great variety of structure in Devonian woods and the diversity of the ancient seed-types, the authors conclude that "if there is any past period which can be fairly singled out as the true age of gymnosperms it must be Devonian time."

H. Hamshaw Thomas has begun a systematic examination of the Middle Jurassic flora of Cleveland in Yorkshire, in which cycads are prominent (*Quart. Journal Geol. Soc.*, London, vol. lxix., p. 223). Wieland's review of "the Williamsonian tribe," in which British specimens from the Yates collection are utilised, will no doubt be referred to as the work goes on (*Amer. Journ. Sci.*, vol. xxxii., p. 433). Both authors point out how we are indebted to Nathorst for additions to our knowledge of the cycad fruits of Yorkshire. F. H. Knowlton compares the Jurassic flora of Cape Lisburne, Alaska (U.S. Geol. Survey, Prof. Paper, 85-D, 1914), with that described by Heer and Seward from Amurland in eastern Siberia, and takes the opportunity for a brief review of the Arctic and Antarctic occurrences

on the same horizon. The Alaskan beds (p. 43) are "probably not older than the Bathonian and certainly not younger than the Oxfordian."

E. Wilbur Berry (*ibid.*, 84, 1914) issues a report on the Upper Cretaceous and Eocene floras of South Carolina and Georgia. Ficus is represented in the Cretaceous beds of South Carolina by five species, and the willow, the oak, the myrtle, and the laurel are among the numerous angiosperms present. The author (p. 71) regards this flora, the post-Raritan floras of the eastern States, and the major part, at least, of the Dakota flora, as Turonian and not Cenomanian in age. The Cretaceous flora of Georgia (p. 127) is placed on the same horizon. A small Middle Eocene (Claiborne) flora of seventeen species allows of an interesting discussion of Cainozoic climate in the eastern States. The main features of the modern flora of tropical America extended as far north as latitude 33° in Middle Eocene times, and retreated later towards the West Indies. In the same paragraph on p. 161, this retreat seems to be dated as "toward the close of the Tertiary," and also, on Dall's evidence from marine life, as "at the close of the Oligocene." The bibliography is useful to all workers in early Cainozoic floras, including that of Bovey Tracey in Devonshire.

David White (*ibid.*, 85-E, 1914) emphasises the occurrence of thread-like resinous casts in "mother of coal" and other Palæozoic "coals of high rank," associated in places with megascopic lumps of resin. By the decay of the plant tissues (p. 82), these resinous infillings of secretory canals have become concentrated in undue proportion in the coals.

A paper by F. W. Clarke and W. C. Wheeler (*ibid.*, 90-D, 1914) has a bearing on the occurrence of magnesium carbonate in rocks. It discusses "The Composition of Crinoid Skeletons," and twenty-one species, representing as many genera, are shown to utilise in their hard parts from 7·28 to 12·69 per cent. of magnesium carbonate, when organic matter is eliminated from the analyses. A specimen of *Hathrometra dentata* includes, moreover, 5·73 per cent. of silica, a substance usually present in quantities of about 0·1 per cent. When arranged by localities, it is seen "that the proportion of magnesium carbonate in crinoids is in some way dependent on temperature" (p. 36). Shallow water in the tropics gives the highest percentage. The calcium carbonate is always in the calcite state. The investigation of fossil crinoids, from the Lower Ordovician to the Eocene, shows nothing higher than 2·56 per cent. of magnesium carbonate, except in a Triassic form, *Encrinus liliiformis*, which yields 20·23 per cent. We may conclude that the matrix was in this case dolomitic. It is suggested that infiltration of calcium carbonate has reduced the proportion of magnesium carbonate present in fossil specimens. The organic matter in recent forms, often amounting to 15 per cent., would certainly allow of the substitution of some other material during fossilisation.

Ivor Thomas's first section of his revision of "The British Carboniferous Producti" (Mem. Geol. Survey of Great Britain, Palæontology, vol. i., part 4, 1914) covers the genera Pustula and Overtonia, which are here established (p. 259) on *Productus pustulosus* and *fimbriatus* respectively. But the special importance of the memoir lies in the review of the Producti generally, based on the work of several years. Doubt is thrown (p. 229) on the clasping nature of the spines of Productus, and it is suggested that a spine during growth may occasionally be diverted by an adjacent object, so as to appear to fold around it. Both external and internal features of the shells are discussed in relation to the animal as it lived, and no apology is needed for the consideration of the general principles of mutation and the meaning of species, questions that have naturally forced themselves before the philosophic author.

It is interesting to note, in L. W. Stephenson's study of the "Species of Exogyra from the Eastern Gulf Region and the Carolines" (U.S. Geol. Survey, Prof. Paper 81, 1914) that the genus was first described by T. Say in 1820, the type being *Exogyra costata* from the Cretaceous of New Jersey. The "Sby." after the name in Woodward's "Manual of the Mollusca," 1851, is probably a mere misprint. *E. costata* is shown regularly to succeed *E. ponderosa*, the species having thus a zonal value. The strata are described in the same memoir.

In vol. xlii. of the Records of the Geological Survey of India (1912, p. 1), R. Bullen Newton and E. A. Smith have directed attention to the survival of a well-known Miocene oyster, *Ostrea gryphoides* (=*crassissima*), in recent marine deposits under Calcutta and in the Bay of Bengal.

Passing to arthropods, C. D. Walcott gives us a new genus of trilobites, Saukia, with numerous species, separated from Dikellocephalus by the possession of a longer glabella and pygidium ("Dikelocephalus and other Genera of the Dikelocephalinæ," Smithsonian Miscell. Coll., vol. lvii., 1914, p. 345). On p. 363 the author explains the common retention of D. D. Owen's spelling of Dikellocephalus with a single "l," under a rule that was surely established by persons with limited glabellas. Osceolia and Calvinella are here founded on *D. osceola* and *D. spiniger* (p. 388) respectively, though on p. 365, probably by a slip, the latter species is referred to Saukia. It seems from p. 364 that Walcott is unwilling to recognise Dikellocephalus from any locality outside the United States, and this should lead to a new examination of British and other European forms. The Devonian faunas of South Africa and South America receive a new link in the discovery by S. J. Shand of a species of the Brazilian trilobite Pennaia in the Bokkeveld Beds of the Hex River in the Cape Province (Trans. Geol. Soc., S. Africa, vol. xvii., 1914, p. 26).

Alexander Petrunkevitch has produced "A Monograph of the Terrestrial Palæozoic Arachnida of North America" (Trans. Connecticut Acad. Arts and Sciences, Yale University Press, 1913). This is a systematic review, not quite so extensive as its title would imply, of the American Palæozoic types of scorpions and spiders, involving the establishment of new genera and species. The author directs attention (p. 20) to the recent work of Clarke and Ruedemann, which indicates a relationship of the eurypterids with the succeeding limuloids, rather than with the scorpions, although the three groups may have had separate ancestors. The Carboniferous arachnid faunas of Europe and North America are stated to be distinct (p. 26); but both have a more tropical character than is found locally in their modern representatives. The excellent photographic plates are from specimens developed with much care by the delicate chiselling away of flakes of rock in order to reveal appendages.

R. Broom records (Bull. Amer. Mus. Nat. Hist., vol. xxxii., 1913, p. 563) his studies of a number of Permian labyrinthodont skulls in the American Museum, in which he has succeeded in tracing sutures hitherto obscure, and thus in providing new descriptions of the cranial elements.

R. S. Lull describes (*Amer. Journ. Sci.*, vol. xxxvii., 1914, p. 209) a "Fossil Dolphin from California," which is presumed to be of Miocene age. The specimen is placed under the living genus Delphinus,

which is thus added to the few mammalian genera that have come down to us unmodified from older Cainozoic times.

A wide interest is attached to the investigation of the "Paleocene Deposits of the San Juan Basin, New Mexico," by W. J. Sinclair and W. Granger (Bull. Amer. Mus. Nat. Hist., vol. xxiii., 1914, p. 297), since these beds contain the oldest known Cainozoic mammals. The famous Puerco clays rest unconformably on a conglomerate with silicified tree-stems, below which are shales containing deinosaurs. No deinosaurs have been found in the Puerco Beds, and the faunal change is even here remarkably abrupt. Fossil plants, of no stratigraphical import, have been found for the first time (p. 306) in the Puerco Beds.

Among faunistic papers, we may note that the indefatigable C. D. Walcott reviews, with a bibliography, the "Cambrian Faunas of Eastern Asia" (Smithson. Miscell. Coll., vol. lxiv., 1914, p. 1).

G. A. J. C.

THE PLACE OF LAVOISIER IN THE HISTORY OF CHEMISTRY.

A SOMEWHAT novel view of "The Place of Lavoisier in the History of Chemistry" is put forward in a paper contributed by A. Mieli to the April number of *Scientia*. This question has formed the subject of prolonged controversy, and has called forth the most diverse and contrary opinions. Some, with Wurtz, have boldly acclaimed the fact that "Chemistry is a French science. Its founder is Lavoisier, of immortal memory." Others have written him down as a mere plagiarist, who purloined from Priestley the discovery of oxygen, and from Cavendish the discovery of the composition of water, and thus built up a great reputation on the unacknowledged work of his English colleagues. The Italian writer asserts that these claims and counterclaims are based upon a misconception. Lavoisier's true place is not at the beginning of the period to which the atomic and molecular theories belong, but at the close of an earlier period in which the chief problems were the nature of combustion, and the composition of air and water. This period opens with Jean Rey and Boyle; John Mayow had practically reached a true solution of the main problems in 1674; but Becher and Stahl intervened, and it was only by the work of Black, Priestley, Cavendish, and Lavoisier that all difficulties and doubts were finally cleared away. Lavoisier's position in the historical sequence enabled him to use all the information and experience that had been gathered during the preceding 150 years, and it was right that he should do so, though his acknowledgments to Priestley and to Cavendish might well have been more generous.

But whilst Lavoisier contributed a brilliant finale to the earlier period, his work cannot be regarded as forming in any sense an overture to the period which followed. The chief topics to be studied in the later period were those which were concerned with atoms, molecules, and equivalents. This period began with Dalton's atomic theory and the controversy between Proust and Berthollet on the subject of fixed or variable proportions; Avogadro (like Mayow) almost solved the problem; but once again a long interval of doubt and confusion ensued, until at last the work of Dumas, Laurent, and Gerhardt, and, above all, St. Claire Deville's discovery of dissociation, enabled Cannizzaro to put forward the masterly exposition which finally dispelled the uncertainty and perplexity which had afflicted chemistry for nearly forty years.

Cannizzaro, like Lavoisier, owed much to others. His experimental work was on a much smaller scale than Lavoisier's; but he is universally honoured as the man who cleared away the obstacles that had hindered the progress of knowledge during many weary years. Lavoisier's chief claim to immortality is of a similar character. It rests upon the fact that he was able to break through the entrenched lines of the "phlogiston" theory, and to make a broad gap through which others could enter the open plain beyond. His tragic death prevented him from reaping the full fruits of his victory over error, and it was left to others to undertake the conquest of the fertile country into which he had opened the way.

The periods suggested by the author are described in a paper communicated to the Italian Chemical Society (*Rendiconti Soc. Chim. Ital.*, 1914, vol. viii.) as follows:—

(1) The Philosophic Period, 600 to 300 B.C., including the writings of Empedocles, Aristotle, and others. (2) The Ancient Alchemistic Period, extending to about 1000 A.D., and dominated by the writings of Geber. (3) The Alchemistic Period of the Middle Ages, extending to about 1400 A.D., and including such names as Avicenna, Roger Bacon, Raymond Lully, Albertus Magnus, and the pseudo-Geber. (4) The Period of the Renaissance, including the work of Agricola (1494–1555), Bernard Palissy, and Paracelsus (1493–1541). (5) The Iatro-Chemical Period, originating with Paracelsus, and culminating in the work of van Helmont (1577–1644). (6) The Pneumatic Period, beginning with Boyle, including Stahl, Black, Cavendish, Priestley, and Scheele, and brought to its conclusion by Lavoisier. (7) The Period of the Modern Atomic Theory, beginning with Dalton, carried forward by Gay Lussac, Avogadro, Ampère, Davy, and Berzelius, and brought to completion by the exposition of Cannizzaro. (8) The Period of Organic Chemistry and of the Periodic Law, including Liebig, Wöhler, and Dumas, on the one side, Mendeléeff and Lothar Meyer on the other. (9) The Period of Physical Chemistry, originating with van't Hoff and Arrhenius. (10) The period of Radio-activity.

T. M. L.

FISHERY RESEARCH IN INDIA.[1]

MR. SOUTHWELL deserves the thanks of those interested in the better organisation of Imperial resources for summarising the history of fisheries research in India. That dates back only to 1906, for the work of Dr. Francis Day and Colonel Alcock was purely systematic. In 1906 economic research was initiated. Sir K. Gupta, then about to retire from the higher ranks of the Indian Civil Service, was ordered to inquire into the fisheries of Bengal. This officer tells us himself that he "knew nothing of fish," and that he "had not even done anything with the rod and line." Nevertheless, he made a lengthy tour in Europe and America to see those who did know, and on his return to India a Bengal Fisheries Department was established, with Mr. A. Ahmed as Commissioner.

The Department then obtained the services, for a year or so, of Dr. J. T. Jenkins, and an English steam trawler, the *Golden Crown*, was sent out to make a survey of the fishing grounds in the Bay of Bengal. While this was going on Mr. Ahmed established a Board which met five times, after which he "ceased to be Commissioner." The result of a very imperfect survey was the formation of a Fishery Department consisting of two directors of agriculture ("whose knowledge of the fisheries is necessarily of an entirely administrative nature"), of Mr. Southwell himself (a trained zoologist), as deputy-director, and

[1] Report on Fishery Investigations in Bengal, etc., with Recommendations for Future Work. By T. Southwell, Deputy Director of Fisheries for Bengal, etc. Bulletin No. 5. Department of Fisheries, Bengal. (Calcutta: The Bengal Secretariat Book Depot, 1915.) Price 6*d*.

of two superintendents of fisheries. One of these latter officials graduated at Calcutta University as M.A. in light and acoustics, and afterwards carried on physical research, and the other was a student at the same University, but "failed to take his B.A. degree." The Department is allowed the use of a laboratory at the Indian Museum, and has also a laboratory on board a steam launch. Thus staffed and equipped it is proceeding with the investigation of Bengal fisheries!

The latter are fresh-water, estuarine, and marine. The edible fresh-water fishes are mainly various species of carp, and a Clupeoid fish called the hilsa. The carps breed in the rivers during the rains, and since extensive areas of Bengal are then flooded enormous numbers of fry are lost in the paddy-fields. How to make good this loss by artificial culture, and also how to deal similarly with the hilsa are obvious problems, neither of which was solved by Dr. Jenkins or Mr. Southwell. The estuarine fisheries are located in the Sunderbans—that is, the rivers, swamps, and islands formed by the deltas of the Ganges and Brahmaputra. Here there are abundant edible fishes and crustacea, but no edible mollusca. The fishing grounds are far away from the traffic routes, and the fishing boats and gear are crude and inefficient. The fauna of the Sunderbans is not even adequately investigated. Dr. Jenkins spent thirty days there with an imperfectly equipped steam launch. Mr. Southwell tells us that Dr. Jenkins showed that "the fish fauna varied greatly according to degree of salinity, depth of water, etc., and observed that nets suitable for fishing in one part of the estuaries might be unsuitable in other parts"—results that might have been predicted! He also concluded that a "properly organised scheme of development of these fisheries would yield a profitable return on capital invested"—an equally indisputable conclusion!

Much more is known about the prospects of a marine fishery. Colonel Alcock regarded the fishery of the Bay of Bengal as of very great potential value. There are numerous species of edible fishes, mostly Siluroids, Scienoids, Serranoids, Pleuronectids, and Clupeoids. Dr. Jenkins and Dr. Annandale, of the Indian Museum, have made good reports on the collections made by the former. The *Golden Crown* was an inefficient and poorly equipped steam trawler, and was, moreover, hampered in its work by the Commissioner of Fisheries, but Dr. Jenkins showed that it was possible to trawl in the Bay of Bengal throughout the whole year. The vessel caught, on the average, 26·6 cwt. of fish a day. (The average catch per day's absence from port of an English steam trawler varies from about 60 cwt. to about 9 cwt., according to the fishing ground. The average catch per day for the North Sea, before the war, was about 17 cwt.) If it were possible to eat, with pleasure, all the species of fish caught, the *Golden Crown* therefore had good results. Dr. Jenkins showed also that it was possible to send fish in good condition to the Calcutta markets, and that the difficulty of navigation of the Hooghly could be evaded. There was reason for believing that European fishery methods would succeed in the Bay of Bengal.

But so far they have not been attempted, nor has the development of the fresh-water and estuarine fisheries been seriously attempted. One's impression in reading the report is that of a Department which, having the conviction that something ought to be done, yet contents itself by doing it badly. Commercial exploitation is, of course, a matter for private enterprise, but it is "up to" the Department which has modelled itself on European lines to see that scientific research is adequately promoted. J. J.

VENTILATION AND HEALTH.

A NEW YORK State Commission on Ventilation has been established by the New York Association for Improving the Condition of the Poor, with the help of a grant from Mrs. E. M. Anderson. The Commission consists of the university professors respectively of physiology, chemistry, psychology, and clinical medicine, together with a ventilating engineer and an officer of the New York State Department of Health, all of whom give their time voluntarily. A Commission so constituted ought to produce results of great value. An experimental chamber has been put up and equipped with all necessary apparatus, and researches have been made into the conditions of schools, hospitals, business houses, etc. The Commission has now issued its first report. The report confirms the view that the physical, rather than the chemical, conditions of the air are of the greater importance. That temperature, humidity, and movement or the air and its freedom from dust, bacteria, and odour are the first essentials of ventilation.

Stagnant air at the same temperature as fresh air, even when it contains twenty or more parts of carbon dioxide, and all the organic and other substances in the breathed air of occupied rooms, has, so far, shown no effect on any of the physiological processes, except that the appetite for food may be slightly reduced.

Here we have confirmation of the view recently expressed in these columns by Prof. Leonard Hill, that stagnant air by reducing the metabolism of the body impoverishes the health and vigour of the body. Over-heated rooms produce a slight but distinct elevation of body temperature, increase the rate of the heart in the reclining posture, and its acceleration on rising from the reclining to the standing posture, and slightly lower the systolic blood pressure. The increased heart rate and diminished blood pressure found in the standing position show how the heated atmosphere relaxes the tone of the body, and tends to make the blood sink down into the dependent parts, and so produces sensations of fatigue, and reduces the inclination to work. The physiologist of the Commission, Prof. Fred S. Lee, determined after exposing cats to over-heated rooms that their excised muscles were more easily fatigued than those of the controls—14–26 per cent. less work was done. The sugar in their blood was also diminished.

In a commercial establishment employing about 4000 clerks, it was found that the building was grossly overheated. The fault lay in large part with the disrepair into which the thermostats had been allowed to fall. In certain ducts designed for fan ventilation no fans had been installed, while in others the fans were running at only a fraction of their efficient speed. In other ducts the register openings were so badly adjusted that while some rooms received more air than needed, others received less.

In one hospital in New York notorious for its overheating, records of 70°, 74°, and two 75° and above were obtained. In the children's wards five out of eleven records were more than 70° F. In one hospital the children's ward was 76° in the daytime. The Commissioner regards anything below 70° F. as free from over-heating!

Abominable conditions are proven then in certain institutions in New York, conditions which sap the health and vigour of the young, and turn them, so to speak, into weak hothouse plants. General recognition is required that the chief aim of ventilation is to provide a moving current of cool air, to remove the heat produced by human metabolism, and by the

combustion of illuminants. The Commission, so far, has added a considerable amount of useful information and evidence confirmatory of the views held by physiologists in this country.

The Commission points out how in the case of a school building the chosen architect strives to outdo the others in the size and ornamentation of the building, and to satisfy the excessive requirements of the school committee. Then begins the process of trimming, and the heating and ventilating plant being the biggest single item of equipment, comes in for the most attention, with the worst results. And this, too, despite the fact that the ventilating plant is really the lungs of the building, and counts most for the comfort and efficiency of the occupants. "But, of course, there must be so many rooms, just so many gargoyles, and just so much marble. For these things are seen and read of all men."

THE UTILISATION OF SOLAR ENERGY.[1]

IN the first part of the paper referred to below are given particulars of the various apparatus which have been used to obtain power from solar radiation. In doing so the author was able to describe in fair detail the construction of such apparatus, but he stated that he had been unable to get any but the most meagre information as to the results obtained with the various plants, and much of that appeared to be untrustworthy. The case was very different in regard to Shuman's work since and including the year 1910, for the author himself had conducted the experiments with Shuman's plants.

Shuman set out with the idea that the principle of former workers in this field of using high-pressure steam was wrong. He argued that high-pressure steam meant a high temperature, and therefore a large loss due to radiation. We shall see later that though this is true, a better overall efficiency is attained when the steam pressure is higher and the boiler area is reduced, so as to save loss due to radiation. It is also a thermal advantage to have a high concentration of the solar radiation, but Shuman started first of all without any concentration (which has its advantages by reason of simplification); then he used a concentration of two to one, and finally 4·6 to one.

As steam was to be generated at a low (say atmospheric) pressure, an efficient engine for the use of such steam had to be designed, and in this Shuman was uniquely successful, for when the author tested a Shuman low-pressure engine at Erith he found that its steam consumption was only 22 lb. of steam at 16·2 lb. sq. in. abs. per b.h.p. hour, the b.h.p. being 94·5. This beats all the old atmospheric engines, and indeed everything to date for steam at that pressure.

Shuman's 1910 sun heat absorber had an area of only 15 sq. ft., and the tests made with it showed that at its best 300 sq. ft. of it would be required to produce enough steam for one b.h.p., allowing the aforementioned 22 lb. per b.h.p. hour.

In 1911 Shuman made another absorber like that of 1910, except that it had two plane silvered glass mirrors, one attached to the upper edge of the "hot-box" and one to the lower, and so arranged that 2 sq. ft. of solar radiation were concentrated on to 1 sq. ft. of boiler surface. The hot-box (originated by H. B. de Saussure, the Swiss geologist, physicist, and naturalist, who died in 1799) was 3 ft. wide, 6 in. deep, and 66 ft. long. There were twenty-six such sections. The back was formed of $\frac{3}{8}$-in. millboard, on top of which was 2 in. of cork-dust, covered with $\frac{1}{4}$-in. millboard. The laminar boiler (about $\frac{1}{4}$ in. thick) was fixed in front of this, leaving an air space of an inch between it and the millboard. In front of the boiler was another air space of an inch, then a sheet of window-glass, another air space of 1 in., and finally the top sheet of window-glass. 10,296 sq. ft. of solar radiation were thus collected, and the best hour's run gave 816 lb. of steam at a pressure of 14·2 lb. sq. in. abs., equivalent to 26·8 b.h.p. and a thermal efficiency (of the absorber alone) of 29·5 per cent.

FIG. 1.—General view from the west of the Shuman absorber, Tacony, 1911.

The orientation of these reflectors was east and west, and they did not "follow the sun," consequently the output of steam fell off considerably in the morning and evening. The solar radiation was received on only *one* side of the 1911 boiler, while the other side lost some of it, but, due to Prof. C. V. Boys, F.R.S., the boiler which the author tested in Egypt in 1913 received heat on both of its sides, and its top edge as well, and the concentration was 4·6 to 1. The orientation of the reflectors was north and south, and they were made automatically to "follow the sun." Each reflector was trough-shaped, parabolic in cross section, 13 ft. 5 in. across the top and 205 ft. long, and there were five such sections. Hence 13,752 sq. ft. of solar radiation were collected. The

[1] Abstract of a paper read before the Royal Society of Arts on April 28 by A. S. E. Ackermann.

cast-iron boilers had a perimeter of 2 ft. 11 in., and were 205 ft. long. They were tested both naked and covered, the covering being formed of one layer of window-glass, butt jointed, and the best results were obtained when they were so covered. The best run of an hour gave 1,442 lb. of steam at a pressure of 15·8 lb. sq. in. abs., equivalent to 55·5 b.h.p. = 63 b.h.p. per acre of land occupied by the plant; while the

$$\eta = \frac{Dsa - pk(T^4 - \frac{2}{3}A^4) - (1-r)Dsa}{Dsa} \quad . \quad . \quad . \quad (1)$$

and to the overall efficiency it is :—

$$\eta_0 = \frac{\{Dsa - pk(T^4 - \frac{2}{3}A^4) - (1r)Dsa\}(T - 568)}{Dsa} \quad . \quad (2)$$

The coefficient $\frac{2}{3}$ appears with the A^4, because the mirrors encircled only $\frac{2}{3}$ of the perimeter of the boiler.

FIG. 2.—Shuman-Boys absorber, Meadi, 1913. One section of the absorber from the north.

average power for the five hours' run on that day (August 27, 1913) was 59·4 b.h.p. per acre, and the minimum on the same day was 52·4 b.h.p. per acre, a decrease of only 16·8 per cent. The maximum thermal efficiency of the absorber alone was 40·1 per cent., or 36 per cent. better than the thermal efficiency of the 1911 absorber, while its steam production was 33⅓ per cent. better.

The author's experiments in Egypt show that a *de*crease of 20 per cent. in the humidity of the atmosphere caused an *in*crease of 30 per cent. in the steam production.

Nearly all the technical part of the paper is contained in three appendixes, while a fourth consists of the bibliography of the subject.

In appendix i. it is shown that when the 1913 absorber was tested with naked boilers, the solar heat not used, and expressed in B.T.U. per hour per sq. ft. of boiler surface per 1° F. difference in temperature between the boiler and the air, is nearly constant and equal to 8·68.

In appendix ii. is derived the equation to thermal efficiency of a solar heat absorber and the efficiencies calculated by means of it are compared with the actual thermal efficiencies.

In appendix iii. the equation to the thermal efficiency of the absorber is combined with the equation to the thermal efficiency of a Carnot engine, thus giving the overall thermal efficiency. From this it is shown that the theoretical maximum overall efficiency of the 1913 Egyptian plant was 5·9 per cent., while the actual efficiency was 4·32 per cent. Thus 73·2 per cent. of the maximum possible efficiency was attained.

The equation to the thermal efficiency of the absorber is :—

Inserting the values of the known quantities for the Egyptian plant gives :—

$$\eta_0 = 0{\cdot}71 - 404T^{-1} + 9{\cdot}45 \times 10^{-10}T^3 - 1{\cdot}664 \times 10^{-12}T^4 \quad (3)$$

where D = the width in feet of the reflector; p = the perimeter in feet of the boiler; r = the efficiency of silvered glass as a reflector of heat; s = the solar constant in B.T.U. per square foot per min. = 7·12; a = the coefficient of atmospheric transmission; T = the absolute temperature in degrees F. of the boiler; A = the absolute temperature in degrees F. of the

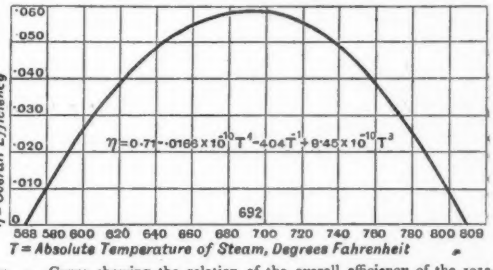

FIG. 3.—Curve showing the relation of the overall efficiency of the 1913 Shuman-Boys sun-heat absorber (with naked boiler), combined with a Carnot engine, to the absolute temperature of the boiler steam.

reflectors; 568 = the absolute temperature in degrees F. of the condenser; k = the coefficient of radiation, conduction, and convection = $10^{-10} \times 0{\cdot}36$ B.T.U. per sq. ft. per min., this value having been determined by the author in 1899 under almost the same conditions as those to which it is now applied.

The graph of equation (3) is given in Fig. 3, from

which it is seen that for a naked boiler, *i.e.* one without a glass cover, the maximum overall efficiency obtains when T=692° F. corresponding with a steam pressure of 21 lb. sq. in. abs. Or, of course, if equation (3) be differentiated with regard to T, and the result equated to 0, we also obtain T=692° F., from which is obtained the maximum value of η_0.

THE RIGID DYNAMICS OF CIRCLING FLIGHT.[1]

ONE of the main objects of the investigation described in this paper is to ascertain the conditions which render it easiest to steer an aeroplane in a horizontal circle of any radius that is not too small, and the idea of "inherent controllability" has been introduced to denote the property which a system may possess of freely describing a circular path without any pressure on the controlling rudders. In such cases the rudders will act as guides by preventing the aeroplane from leaving the chosen path, and as the system without them must, from the nature of the case, be wanting in directional (lateral) stability it is necessary for the working of such a system that the addition of the rudders should render it stable. The conditions for this must be worked out by the methods described in the lecturer's book, "Stability in Aviation."

It will be found that there are several different ways of obtaining inherent controllability and that in circling flight the system turns about a point which in some cases is in front and in some cases behind the centre of gravity. The axis of x or horizontal line through the centre of gravity in the direction of forward motion thus envelopes a circle of radius, a, the "turning point" being the point of contact of the axis tangent with its envelope, and the lateral or sideways velocity of the aeroplane being proportional to the distance of the centre of gravity from the turning point. This length and the inclination of the aeroplane to the vertical constitute two independent variables which can be so chosen as to satisfy two conditions of lateral equilibrium, but as there are three, a third variable is in general required, and if a rudder plane is used, this latter variable may be taken to be the pressure on that plane. The condition for inherent controllability is that the three equations of lateral equilibrium should satisfy some further identical relation by which the number of variables is reduced to two, and there are several ways in which this may be done.

The results here summarised lead to some interesting conclusions which were quite unexpected when the paper was commenced. In particular, they show the differences in behaviour between wings that are bent up and down respectively, the advantages, in certain circumstances, of curved wings as contrasted with plane wings bent into a simple dihedral angle, and generally that the form and curvature of the wing areas may play a much more important part in circling flight than had been anticipated.

The applications to the flight of birds are obvious, and suggest much interesting material for discussion. At any rate, a good many peculiarities in the wing structure of the circling birds appear to admit of interpretation on dynamical principles.

With regard to the possible application of these results to actual areoplanes, it remains to be seen how far it is desirable or practicable to realise the conditions of inherent controllability in a real flying machine. But the lecturer suggested that a study of the present work, followed by a few experiments, will either lead to improvements in the steering of aeroplanes, or if the present arrangements are the best, it will now be easier to understand the reason why.

[1] Abstract of the third Wilbur Wright Memorial Lecture delivered before the Aeronautical Society on May 20, by Prof. G. H. Bryan, F.R.S.

Summary and Conclusions.

(1) In steady motion in a horizontal circle, both the longitudinal and the lateral equations of equilibrium are affected.

(2) The turning point may be in front of or behind the centre of gravity, its distance when in front being denoted here by b.

The axis of the aeroplane then envelopes a circle of a certain radius a, the real radius of the circle described being $\sqrt{(a^2+b^2)}$.

The system usually cants over sideways through a certain agle ϕ.

(3) Given the velocity and radius of the circle it is not usually possible to satisfy the three equations of lateral equilibrium by assigning suitable values to b and ϕ, but when this is possible the system is said to be inherently controllable.

In an inherently controllable system the rudder planes merely act as guides, and it is necessary that they should be so placed as to render the motion laterally stable.

In other cases steady motion can only be maintained by pressure exerted by the rudders or a couple applied by means of *ailerons* or some such action representing the third unknown variable required for the solution of the three simultaneous equations of lateral equilibrium.

(4) In a system of straight planes $\sin\phi$ is proportional to the radius a of the envelope, but it also appears that the other conditions of lateral equilibrium are only possible when pressure is applied by means of a rudder, and when a and ϕ have certain definite values. The only way of varying the radius of the circle actually described is by varying the position of the turning point, which may be in front of or behind the centre of gravity.

The addition of boxed-in ends or vertical partitions improves the steering, but it still leaves $\sin\phi$ proportional to a. The inference one would naturally derive from the formulæ is that all such systems would be liable to sway from side to side of the straight path in curved arcs of finite radius. In no case can the radius of the circular envelope exceed the limit corresponding to $\phi=90°$.

(5) With bent-up wings, as in the "Antoinette type," it is possible to satisfy the conditions of equilibrium so that a is no longer limited and ϕ no longer large. Such a system can be steered in a circle of large radius without being inclined at a large angle.

In general, circular motion can only be maintained when pressure is applied by means of a rudder or a couple applied by means of *ailerons*, but if the two principal moments of inertia about axes perpendicular to the line of flight are equal, the rudder exerts no pressure, and the system is inherently controllable, the inclination satisfying the relation $U^2=ga\tan\phi$.

(6) Another kind of "inherent controllability" in which the system always remains level, the inclination ϕ being zero, is possible in certain systems. A necessary condition is that the wings should be bent downwards and not upwards at the tips, and it will be usually advantageous that they should be most bent down at their extremities. The condition representing this fact is that the space between the wings and a chord joining their tips should be as large as possible.

This arrangement of the wings somewhat reproduces the action of gulls' wings in circling flight, and it will be found that differences in the form and

curvature of the wings may have a considerable influence in the problems of this class.

(7) A third kind of "inherent controllability" is only possible when portions of the wing surface are in front of or behind the rest; and a possible solution exists in the form of a system suggested by the lecturer in the *Aëronautical Journal*, with front and rear planes, one set being turned upwards and the other downwards.

It appears, however, from the analysis that the necessary conditions cannot be satisfied in the case of surfaces of uniform breadth bent up into a plane dihedral angle at the centre or bent into a trihedral angle at some points intermediate between the centre and tips. They can, however, be readily satisfied by *suitably* curving the wings or by varying their shape so as to make them as a rule broader towards the tips than near the base. The present arrangement has the further advantage that the system would not tend to turn round sideways if struck by a side gust of wind, and this should be worth trying experimentally.

(8) Although no attempt has been made to discuss the analytical conditions of inherent stability further than has been done in "Stability in Aviation," it appears from general considerations that the rudder plane at least in an inherently controllable system should be placed on the opposite side of the centre of gravity to the turning point, and that difficulties, probably instability, must necessarily occur if the rudder is between the centre of gravity and the turning point. It seems almost certain that the best position for the rudder is when it and the turning point are in the relative positions of the centres of suspension and oscillations of the system when treated as a compound pendulum.

EARLY RECOGNITION OF THE PHASES OF THE PLANET VENUS.

IN the April number of the Journal of the Royal Asiatic Society there is an article by Mr. Joseph Offord, entitled "The Deity of the Crescent Venus in Ancient Western Asia," which is of interest to astronomers as well as to archæologists, because it shows that the phases of this planet were undoubtedly detected at a very early era indeed.

The evidence adduced commences with a cuneiform inscription from Babylonia, of the time of Assurbanipal, which refers to the horn of the star, and another similar sentence is added from an undated tablet. Mr. Offord then proceeds to consider many statements, chiefly made in ancient inscriptions, as well as in the fragments of classic, Syrian, and Egyptian literature referring to the characteristics of Venus as a stellar goddess, which indicate that the crescent form of the planet at certain intervals was recognised and clearly set forth by the titles, myths, and observances connected with her as a deity. As is well known, Venus, the Asiatic Ishtar, Ashteroth, or Astarte, wore a horned headdress, and was called in consequence Ashtoreth-Karnaim—the Ashtoreth of the horns. The Chaldeans made her the daughter of Sin, the moon-god, because of her similar crescent phases to the moon.

Much of the confusion concerning the titles and attributes of Venus, as a deity, arose from different names being assigned to her as morning and evening star, whilst the classics sometimes erroneously ascribed any stellar goddess said to have crescent form to the moon, because they were unaware that the planet Venus possessed the same characteristic, although the Assyrians and other Semites had recognised this.

That Astarte of the Greeks, and Asheteroth of the Phœnicians was Venus is certain, and that she was only another name for the Chaldean Ishtar Mr. Offord shows definitely. That Ishtar was the morning star the cuneiform texts confirm in many ways. One of her titles, Dilbat, "the Announcer," is cogent in the case; also in a myth when seven evil spirits were said to have worsted the moon, temporarily (*i.e.* an eclipse), Ishtar became queen of heaven, because the moon's light having vanished, Venus had no rival in brilliancy. Moreover, Ishtar had titles such as Simua (horned) and Timua (curved), and is depicted as a cow. The exvotos in many Astarte temples were also cow-heads with large horns.

In the clear air of Mesopotamia it was possible to detect the phases of Venus, as Dr. Gretschel has shown is the case in Persia and Peru; and so Ishtar-Venus, the later Ashtoreth-Karnaim, is like so many other primitive concepts, a reasonable expression of astronomical symbolism, the horned emblem upon figures of the deity indicating the star associated with her name.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BRISTOL.—Mr. G. A. Wills, and his brother, Mr. H. H. Wills, have just made an additional gift of 40,000*l.* to the University. Originally they gave 180,000*l.* for the purpose of erecting additional buildings, but as the accepted tender greatly exceeds that amount, they have now added 40,000*l.*, making a total benefaction of 220,000*l.* The council has decided, therefore, to proceed forthwith with the erection of the buildings.

CAMBRIDGE.—The late Dr. W. Aldis Wright, vice-master of Trinity College, bequeathed the sum of 3000*l.* for the use of the University library. The late Lady Margaret Huggins left 1000*l.* to the City of London School for the endowment of a scholarship in astronomy, tenable at Cambridge, to be called the "Sir William Huggins" scholarship.

Mr. A. E. Dixon has been reappointed assistant to the Downing professor of medicine, and Mr. R. H. Rastall has been reappointed additional demonstrator of geology.

LONDON.—Her Majesty the Queen has given the sum of 250*l.* to pay for the training and expenses of a student at the London (Royal Free Hospital) School of Medicine for Women for a five years' course. The money is part of a gift to the Queen from the wives of Freemasons, to help members of the professional classes who may be in difficulties owing to the war. The council will award the scholarship in July, 1915, to a student who intends to begin a course of study in the October following. The scholarship will be of the value of 50*l.* a year for five years, subject to the student pursuing her course to the satisfaction of the council.

At a meeting of the Senate on May 19, it was decided to close the science department of Goldsmiths' College at the end of the present session.

Dr. A. E. Boycott, F.R.S., has been appointed director of the Graham Research Laboratory in succession to Dr. Charles Bolton.

The D.Sc. in chemistry has been granted to Mr. Percy May, of University College.

There are few changes in the *personnel* of the Senate as the result of recent elections. Dr. H. B. Workman succeeds Dr. T. L. Mears as one of the representatives of arts graduates, and Dr. W. P. Ker succeeds Dr. Pollard as one of the representatives of the faculty of arts. Mr. J. L. S. Hatton and Dr.

A. D. Waller have been re-elected as representatives of the faculty of science.

A course of four lectures on the gases of the blood will be given in the Physiological Laboratory, King's College, Strand, W.C., by Prof. T. G. Brodie, at 4.30 p.m., on May 31, and June 2, 7, and 9. The lectures, which will be illustrated by experiments, are addressed to advanced students of the University and others interested in the subject. Admission will be free, without ticket.

In recognition of his services to technical education, Sir Philip Magnus will be presented with an address and Lady Magnus with a piece of plate by the Association of Technical Institutions on Wednesday next, June 2. Mr. J. H. Reynolds, ex-president, will present the address, and Sir William Mather, the first president, will make the presentation to Lady Magnus. Sir Alfred Keogh, K.C.B., will preside.

It is announced in the issue of *Science* for May 14 that the Rensselaer Polytechnic Institute has received two substantial gifts recently. Mrs. Russell Sage has given 20,000*l*., and Mr. A. T. White, of Brooklyn, 10,000*l*. From the same source we learn that a trust fund of 1000*l*., to be known as the "Edward Tuckerman Fund," designed to increase the interest in the study of botany among the students of Amherst College, has been bequeathed to the college by the late Mrs. S. E. S. Tuckerman, wife of the late Prof. E. Tuckerman.

The governing body of the Manchester Municipal School of Technology (University of Manchester) is offering not more than ten research scholarships in technology during the session 1915–16 at the Manchester School of Technology—one of the value of 80*l*., three of the value of 75*l*., and six of the value of 50*l*., all with fees remitted. Research may be undertaken in mechanical, electrical, or sanitary engineering; in any of seven branches of applied chemistry; and in textile industries. The scholarships are open to graduates of any university in the British Empire, and to other persons possessing special qualifications for research. Holders of the scholarships will be expected to devote the whole of their time to the prosecution of the research upon which they are engaged. The scholarships may be renewed for a second year on the recommendation of the Board of Studies. Forms of application and all information may be obtained, by letter only, addressed to the registrar, School of Technology, Manchester, and all applications must be received on or before June 21.

SOCIETIES AND ACADEMIES.

LONDON.

Zoological Society, April 27.—Prof. E. A. Minchin, vice-president, in the chair.—Mrs. R. Haig **Thomas**: White-collar Mendelising in hybrid pheasants. The paper was based on an examination of the relative numbers of dark-necked and ringed male pheasants shot during two seasons. The data collected were interpreted as providing evidence of the continual Mendelising which occurred in the collar of hybrid birds.—E. G. **Boulenger**: Two new species of tree-frogs from Sierra Leone.—E. **Heron-Allen** and A. **Earland**: Foraminifera of the Kerimba Archipelago, Portuguese East Africa. Part ii. The contents of this part were chiefly systematic, more than 470 species and varieties being dealt with, of which thirty-two are new to science.

May 11.—Dr. A. Smith Woodward, vice-president, in the chair.—Miss E. A. **Fraser**: The head-cavities and development of the eye-muscles in *Trichosurus vulpecula*, with notes on some other Marsupials. The usual eye-muscles, including a well-developed m. retractor bulbi, are present in the Marsupialia. A large premandibular head-cavity, representing the first somite of the head, is found in all the Diprotodontia, and appears to be either absent or of very small size in the Polyprotodontia.—Dr. R. **Broom**: (1) The Organ of Jacobson and its relations in the "Insectivora."—Part ii., Talpa, Centetes, and Chrysochloris. In Part i. it was shown that Tupaia and Macroscelides and their allies must be separated from the typical Insectivores, such as Erinaceus and Gymnura, to form a very distinct and not nearly related order—the Menotyphla. In Part ii. it is shown that Chrysochloris has no near relationship with either the Insectivora or the Menotyphla, and must be made the type of a distinct order, the Chrysochloridea. Centetes, which has hitherto been regarded as allied to Chrysochloris, is more nearly related to Erinaceus, though it differs from it in many points, and may later have been separated from it. Talpa shows many affinities with Erinaceus and a number of differences the value of which is at present not apparent. (2) The Anomodont genera, Pristerodon and Tropidostoma. Pristerodon, described by Huxley in 1868, is a very near ally of Dicynodon, differing mainly in having a series of molars which are smooth in front and have a series of denticulations behind. The males are tusked, the females without tusks. *Oudenodon raniceps* of Owen is a species of Pristerodon; while *Opisthoctenodon agilis*, Broom, and probably also *Opisthoctenodon brachyops*, Broom, are other species of Pristerodon. In 1889 Seeley described two occiputs under the names *Dicynodon microtrema* and *Dicynodon* (*Tropidostoma*) *dunni*. As pointed out by Lydekker, these belong to the one species, *D. microtrema*, and other specimens in the British Museum show that it differs from Dicynodon in the structure of the parietal region and in having molars very similar to those of Pristerodon, but fewer in number. This species is therefore placed in a distinct genus, for which the name Tropidostoma must be accepted.—Mrs. H. L. M. **Pixell-Goodrich**: Minchinia: a Haplosporidian. This papers deals with the life-history of *Minchinia chitonis* (Lankester), a protozoan parasite of the mollusc Chiton. Hitherto this parasite has been considered to belong to the Coccidia, but convincing evidence is here brought forward to show that it is a Haplosporidian. An account is given of the multiplication in the host by plasmotomy and sporogony, and a detailed description of the development of the very characteristic spores.

Linnean Society, May 6.—Prof E. B. Poulton, president, in the chair.—W. Percival **Westell**: Some bird problems. The author discussed anomalies of habit and structure in the order of the list recently issued by the British Ornithologists' Union, and asked for help in attempting to clear up some of the facts narrated.—Dr. Sarah M. **Baker** and Miss Maude H. **Bohling**: The brown seaweeds of the salt marsh.—II. Their classification, morphology, and ecology. Five of the species of Fucoideæ common in Britain as inhabitants of rocky shores are represented by peculiar varieties on the salt marsh. Evidence is brought forward to show that these forms, although they differ widely in their morphology from their rock ancestors, are to be regarded as adaptational varieties or "ecads" in the terminology of Clements. Two general methods have been used to study the correlation between the morphological peculiarities of the marsh Fucoids and the new chemical and physical conditions of their environment. The first is to study the distribution of natural varieties of one species, and the second to examine in detail exceptional cases. These methods have led to the conclusions that dwarf habit is mainly

conditioned by exposure and lack of nutrient salts. Vegetative reproduction is caused by the high humidity maintained over the marsh in the intertidal periods. This prevents the attainment of a limiting concentration in the cell-sap necessary as a stimulus to the formation of sexual reproductive organs. The cause of spirality is probably unequal distribution of nutrient salts. The same factors were shown to be operative in causing the change in morphology of the floating Sargasso weed. Brown seaweeds may function on salt marshes either as pioneer vegetation, undergrowth, or covering vegetation after erosion, and in these capacities often play an important part in the economy of the marsh.—H. N. **Dixon**: A collection of Borneo mosses made by the Rev. C. H. Binstead.

Geological Society, May 12.—Dr. A. Smith Woodward, president, in the chair.—G. **Hickling** and W. R. **Don**: *Parka decipiens,* Fleming. The paper is a joint statement of originally independent investigations of this Old Red Sandstone organism. The views of Fleming, Hugh Miller, Mantell, Lyell, Powrie, Page, and others are quoted to illustrate the chequered career of this enigmatical fossil in geological literature. To Dawson and Penhallow, supported by Reid and MacNair, belongs the credit of making the first serious attempt to obtain definite evidence as to its nature, and of establishing its vegetable character. The present account is based on the observation of great numbers of specimens in the field, and on the microscopic study of impression-material, of thin sections, and of macerated material. The plant is most abundant in the Lower Old Red of the Kincardine-Forfar-Perth area, where it is by far the commonest fossil, especially in the shale-bands; Parka is confined to the lower two-thirds of the Caledonian Series. It is recorded from a few other localities in central Scotland, and also from the Upper Ludlow and Lower Old Red of the "Hereford" area. The organism is shown to be a complete cellular thalloid plant, agreeing generally in its vegetative structure with certain algæ, but differing from all known algæ in the production of cuticularised spores.

Institution of Mining and Metallurgy, May 20.—Sir T. K. Rose, president, in the chair.—J. J. **Beringer**: The physical condition of cassiterite in Cornish mill products. This paper was in course of preparation when the author contracted an illness which ended fatally, and as a consequence it lacks the valuable summary of conclusions which the author would have compiled as the result of his exhaustive series of experiments in a subject to which his last few years had been largely devoted. He had, in fact, made most detailed investigations into the mode of occurrence of the particles of cassiterite in the ores of Cornish lodes and in the mill products resulting from the reduction of those ores, with a view to reducing the losses on the dressing floors. The chief conditions governing his investigations were: the actual measurement of the sizes of the particles; the determination of the rate at which particles of various sizes settle in still water and against upward currents, with methods of separating and collecting particles of a given size; the compilation of tables showing specific gravity and assay value of particles in relation to their size; a study of the action of particles of various sizes in their passage over various forms of concentrating machinery; and, finally, an investigation of some special mill-products, and a general study of the mineral cassiterite as found in some Cornish lodes. For reporting the mean diameter of particles as measured under the microscope the author used the micrometric unit of one-thousandth of a millimetre, and established a relationship between that form of measurement and a classification based on the rate of falling in still water and the different rates of upward current between which the particles in a mixture can be separated. The paper contains an attempt to give a definite size value to the much-discussed terms "sand" and "slime," with further subdivisions of the latter condition into "silt," "fine silt," and "clay." A valuable section of the paper deals with the action of the material when passing over concentrating machinery, different types of which were experimented with in great detail. In an appendix are given valuable hints on the uses of the microscope in determining the size and nature of minerals, a subject which Mr. Beringer brought forward at a meeting of the institution shortly prior to the preparation of the material embodied in this paper.—H. F. **Collins**: Note on the concentration of gold in bottoms in the converter. With a view of utilising the gold contents of converter copper which is not rich enough to make electrolytic refining profitable, by means of a partial oxidation of the bath of white metal to "pimple" metal and "bottoms," and the separation of the latter before completing the oxidation, the author devised a simple method of treatment which has been in actual practice for about a twelvemonth. In this method a small acid-lined converter is used, provided with a taphole opposite the tuyeres, which, during the process of blowing to precipitate, is closed by a plug of clay attached to an iron rod. When the metal is thoroughly molten, the bar is withdrawn and the copper allowed to run off into moulds until white metal appears in the stream, when the taphole is closed and the converter returned to position for the next similar operation. The success of the method depends primarily on running the charge hot, losing no time in skimming and not adding too much cold scrap after skimming, so that the reduced copper is well above the melting point of "pimple" metal.—Donald M. **Levy** and Harold **Jones**: The Morro Velho method of assay of gold-bearing cyanide solutions. The method here described is based on the precipitation of the gold by means of a zinc-lead couple from the boiling solution in the presence of suitable quantities of silver and lead salts. By this means, sufficient silver is introduced to yield with the gold a suitable parting alloy. The presence of the lead salts causes the production of a lead-zinc couple which facilitates the complete liberation of the metallic gold from solution, and yields a bulky precipitate of the lead and values which settles easily and thus ensures carrying down the precipitated gold.—F. A. **Eastaugh**: The effect of different methods of crushing on the ash of coke. The object of the experiments here described was to find the true ash contents of the coke, in order to discover whether the discrepancies occurring so frequently between the amount of ash found by sellers and buyers are due to different methods of preparing samples for test purposes. In the experiments, all made from one parcel of metallurgical coke, remarkable differences resulted from the employment of different methods of crushing the samples.

PARIS.

Academy of Sciences, May 17.—M. Ed. Perrier in the chair.—G. **Humbert**: The positive binary quadratic forms.—D. **Eginitis**: Observations of the Mellish comet (1915*a*) made at the Observatory of Athens with the Doridis equatorial (40 cm.). Positions are given for April 8, 10, 13, 14, 15, 21, and 22.—Ernest **Esclangon**: The quasi-periodic integrals of a linear differential equation.—Maurice **d'Ocagne**: Remarks on the subject of circular anamorphosis.—A. **Buhl**: New geometrical applications of the formula of Stokes.—Daniel **Berthelot**: Calculation of the Despretz-Trouton constant. By combining the equation of Van der Waals with the law of the rectilinear diameter of Mathias, the ratio of the internal latent heat of

vaporisation to the absolute boiling point was found to be 9, or half the experimental value. But using the characteristic equation for a gas given by the author in 1900, in place of the Van der Waals equation, the Despretz-Trouton constant is 18, in exact accord with experiment.—E. **Léger**: Magnesium citrate and the supposed basic magnesium citrates.—O. **Bailly**: The synthesis of α-glycerophosphoric acid. Sodium allylphosphate, treated with potassium permanganate, gives the α-glycerophosphate free from the β isomer. The solubilities of the calcium, barium, and strontium salts were determined.—J. **Bergonié**: The detection, localisation, and extraction of magnetic projectiles by means of the electro-vibrator. A summary of the advantages of this method as compared with the usual surgical operation with the assistance of the X-rays.—Félix **Legueu**: Biological reactions in prostatic adenoma.

BOOKS RECEIVED.

Catalogue of the Ungulate Mammals in the British Museum (Natural History). Vol. iv. By R. Lydekker. Pp. xxi+438. (London: British Museum (Natural History); Longmans and Co., and others.) 10*s.* 6*d.*

The Principles of Agriculture through the School and the Home Garden. By C. A. Stebbins. Pp. xxviii+380. (New York: The Macmillan Company; London: Macmillan and Co., Ltd.) 4*s.* 6*d.* net.

Societal Evolution. By Prof. A. G. Keller. Pp. xi+338. (New York: The Macmillan Company; London: Macmillan and Co., Ltd.) 6*s.* 6*d.* net.

A Report on Library Provision and Policy by Prof. W. G. S. Adams to the Carnegie United Kingdom Trustees. Pp. 104. (Edinburgh: Neil and Co.)

Three-Colour Photography: with Special Reference to Three-Colour Printing and Similar Processes. By A. Freiherrn von Hübl. Translated by H. O. Klein. Pp. 138. (London: P. Lund, Humphries and Co., Ltd.)

The Material Culture and Social Institutions of the Simpler Peoples. By L. T. Hobhouse, G. C. Wheeler, and M. Ginsberg. Pp. 299. (London: Chapman and Hall, Ltd.) 2*s.* 6*d.* net.

Surveying and Field Work. By J. Williamson. Pp. xxii+363. (London: Constable and Co., Ltd.) 7*s.* 6*d.* net.

Single-Phase Electric Railways. By E. Austin. Pp. xiv+303. (London: Constable and Co., Ltd.) 21*s.* net.

La Science Allemande. By Prof. P. Duhem. Pp. 143. (Paris: A. Hermann et Fils.)

Continuous Current Electrical Engineering. By W. T. Maccall. Pp. viii+466. (London: University Tutorial Press, Ltd.) 10*s.* 6*d.*

DIARY OF SOCIETIES.

THURSDAY, MAY 27.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Annual General Meeting.

FRIDAY, MAY 28.

ROYAL INSTITUTION, at 9.—Engineering Problems of Mesopotamia and Euphrates Valley: Sir John Jackson.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 8.—The Evolution of the Oil Tank-ship: H. Barringer.

PHYSICAL SOCIETY, at 5.—Numerical Relations between Electronic and Atomic Constants: Dr. H. S Allen.—A Method of Calculating the Absorption Coefficients of Homogeneous X-Radiation: H. Moore. Two Experiments Illustrating Novel Properties of the Electron Currents from Hot Metals: Prof. O. W. Richardson.—High Permeability in Iron: Prof. E. Wilson.—An Experiment showing the Relative Width of Hydrogen and Neon Lines: T. R. Merton.

SATURDAY, MAY 29.

LINNEAN SOCIETY, at 3.—Anniversary Meeting.

MONDAY, MAY 31.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Geography of the War Theatre in the Near East: D. G. Hogarth.

TUESDAY, JUNE 1.

ROYAL INSTITUTION, at 3.—The Evolution of Steel—Influence on Civilization: Prof. J. O. Arnold.

RÖNTGEN SOCIETY, at 8.15.—Annual General Meeting.

WEDNESDAY, JUNE 2.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Estimation of Starch in Cocoa by the use of Taká Diastase: C. Revis and H. R. Burnett.—The Volumetric Estimation of Ferrocyanides: B. Campbell.—Corean Beeswax: Seiichi Ueno.—Determination of β-Naphthol in Lysol and similar compounds: R. Bodmer.—The Composition of Dutch Cheese: J. J. L. van Ryn.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, JUNE 3.

ROYAL SOCIETY, at 4.—*Probable Papers*: Soil Protozoa and Soil Bacteria: E. J. Russell.—The Chromosome Cycle in Coccidia and Gregarines: C. Dobell and A. P. Jameson.—The Influence of Gases on the Emission of Electrons and Ions from Hot Metals: Prof. O. W. Richardson.—The Shapes of the Equipotential Surfaces in the Air near Long Buildings or Walls, and their Effect on the Measurement of Atmospheric Potential Gradients: Prof. C. H. Lees.—The Band Spectrum associated with Helium: J. W. Nicholson.

ROYAL INSTITUTION, at 3.—Methods of presenting Character in Biography and Fiction: Wilfrid Ward.

FRIDAY, JUNE 4.

ROYAL INSTITUTION, at 9.—Radiations from Exploding Atoms: Sir E. Rutherford.

GEOLOGISTS' ASSOCIATION (at University College), at 8.—Lakes and their Origin, with Special Reference to Rock-basins: Prof. E. J. Garwood.

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Editorial and Publishing Offices:

MACMILLAN & CO., LTD.,

ST. MARTIN'S STREET, LONDON, W.C.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.

Telephone Number: GERRARD 8830.